AUG 18 1925

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July 16, 1925

Engineering News-Record

Placing Concrete in Floor of High Service Reservoir, Washington, D. C.

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Review of Recent Engineering Literature

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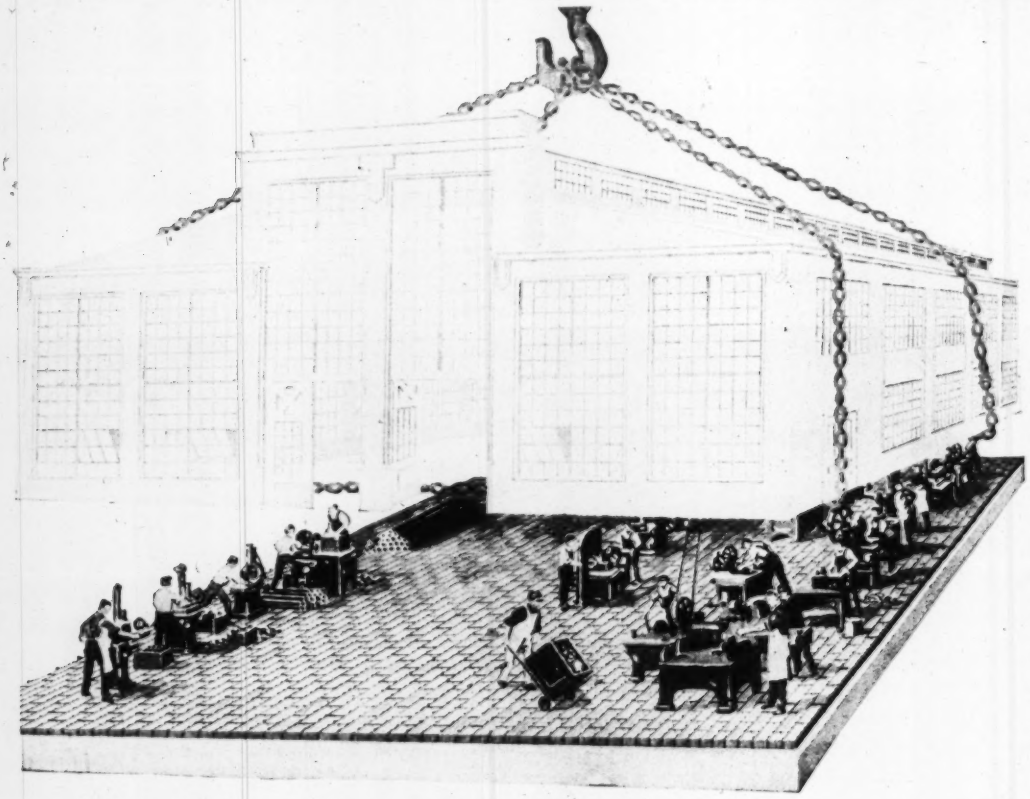

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 95 NEW YORK, JULY 16, 1925 Number 3

Once More the Technical Division

THE meetings of the technical divisions of the American Society of Civil Engineers at Salt Lake last week only confirmed the impression made by the previous three or four meetings that the operation of these divisions is not being successfully worked out. The ambition to promote the technical activities of the society, which was behind the technical division idea, is a laudable one. A professional society's first aim should be to promote the technique of the profession. But the divisions have not only multiplied rapidly but each division has apparently a sense of its own dignity and responsibility which impels it to ask, and the board to grant, a meeting at each of the four major meetings of the society. In consequence we have at each meeting the two or three hundred odd men in attendance scattered around in groups of from ten to forty holding simultaneous sessions in the same building, and discussing in each room weighty subjects, each as a representative meeting of the American Society of Civil Engineers—with upwards of 11,000 members. So ponderous a subject as "The Development of Industrial Sites and Trackage Layouts at Kansas City and Los Angeles, by the Southern Pacific R.R." is accorded a place on a divisional program—and twenty men listen to it. The geographical distribution of the quarterly meetings is good; it brings the society to its members. The technical division idea is good, too, but the board has a real job on its hands fitting the two together.

Code Interpretation

THE resolution of the Board of Direction of the American Society of Civil Engineers on the ethical significance of advertising for engineering advice (p. 106) is significant of a possible change in the policies of the society. There is nothing radical in the resolution, which is a sober, but comprehensive, statement of the obvious, but it may presage an interest in the specific observation of the general code of ethics long since adopted by the society, in which case a radically different prospect opens. The American Association of Engineers and the Institute of Consulting Engineers for some years have been building up a code of professional practice by citation of specific cases and both are now well along toward a body of professional law whereby violations may be traced to a specific instance of prior violation, in other words they are setting up a system of law based on precedent rather than on statute. The American Society of Civil Engineers has consistently refused to attempt such a thing, but has relied on a Mosaic code, with rare appeal to the secret sessions of a committee of the board, when violations of that code were charged. Interpretation of the code thus remained an individual duty—and in consequence the code is practically a dead letter. If the society is really now disposed to march forward to more public and active interpretation of codified law its force in the advancement of professional practice is about to be greatly increased.

Road Grading Studies

CONTINUATION of the earth-moving studies being published by the Bureau of Public Roads in *Public Roads*, its official journal, calls again for reference to the important character of these articles. They have now covered wheel scraper, Fresno scraper and elevating grader operations in their important ramifications. In all, the text published will equal about forty pages of *Engineering News-Record*. This is a book of respectable size. Indeed no equivalent treatise on light earth-moving operations can be secured. Again, also, we assert that highway contractors and engineers should not overlook these articles. They touch on work whose cost is more often poorly estimated than any other task in road building.

Deluding the Commuter

PRESSURE of population in New York City has forced the study of local transportation out of the perennially worrisome field of rapid transit inside the city to the equally troublesome but not until now so active field of suburban transit. With the exception of the gradual extension of subways out into what were once suburbs but what are now only parts of the crowded city the outlying transit service has always been left to the initiative of the respective railroads. They have risen excellently to the occasion in the past but the demands are now getting beyond them. Faced with what is at least an accounting deficit in suburban service—though it has always seemed that their protestations as to such deficits overlooked the many collateral advantages of a crowded suburban service—the railroads now find themselves unable to plan ahead for the almost countless thousands who continue to escape the crowded city as a sleeping place. No relief is in sight in any one of the many commuting railways reaching out in all four directions from Manhattan. Planning, then, has devolved on the state and both New York and New Jersey have commissions at work studying how best can be laid out, and what is much more difficult, can be paid for the hundreds of millions of dollars worth of new commuting lines which will extend and make more flexible, from a transportation viewpoint, the great metropolitan area of New York. Many years, a decade or perhaps a quarter century will elapse, if history of such huge engineering projects is a guide, before these plans even begin to become actualities, but now in their infancy it seems worth while to sound one word of warning. It is evident from the plans made public that the various commissions are considering seriously the dream of every commuter—that he can take a train five minutes walk from his home and be

deposited, from the same train, two minutes walk from his office. This is an impossibility, but the marginal routes down the New Jersey shore and across to Manhattan and the central routes from Westchester down the spine of the island seem to hold out a promise that the commuter's dream will be realized. This is so contradictory of the accepted principle that for efficient loading rapid transit should be dispersed and not concentrated that it would be a pity if the poor commuter should be deluded into belief in any such prospect, even though that prospect would more likely benefit the sons and daughters of the next generation than himself.

Discussing Irrigation

NO GREAT hopefulness spoke from the discussion of present irrigation problems at the Salt Lake meeting of the American Society of Civil Engineers. The difficulties and discouragements facing federal reclamation—low agricultural marketing conditions, a political system that hamstrings efficient administration, and surprisingly high costs of future projects—were more or less frankly recognized. And at the same time is was asserted that private enterprise can hardly take up the coming high-cost developments, since they will probably not pay. But there was no approach to agreement on the way to deal with these difficulties. Agricultural and financial aid was advocated, and also the plan of cutting loose from politics by handling the work through a public corporation; and, as the two systems are in no way antagonistic or directed to the same end, the hearers could also consider a system combining the two. Agricultural over-development was also mentioned, a frankness requiring some courage in the heart of a region that is agitating actively for more federal investment in reclamation. If the fact of over-expansion in irrigation be conceded, it may naturally be concluded that the present is not a good time for further government reclamation. But with this one possible exception, the discussion did not seriously touch the question whether land-development is a proper federal function, though the facts presented were such as to suggest this question very directly. So far as the question centers on theories of government and good public policy, the engineering gathering might well abstain from its discussion. But in another aspect it is very much of a question for engineers: whether, if irrigation development is an unremunerative business, foredoomed to bankruptcy, and therefore not feasible for private effort, it is a fair and proper field for public enterprise. Sooner or later this question must come to the front in discussions of irrigation policy.

In the Line of Progress

IT IS of more than passing interest to record that the Salt Lake discussion of irrigation problems was the most comprehensive and deep-cutting exchange of thought on the subject within memory. The facts and views brought out, some new and some newly expressed, form a contribution to thought on irrigation development that will for years be closely bound up with the problem and its advance toward a solution. The contribution will undoubtedly be made even more important by the full discussion, prepared and reviewed more carefully than that on the meeting floor. No other gathering of recent years, even when composed of enthusiasts with large personal interest in irrigation and reclamation, has done as much—has done anything, we may almost claim—to advance the status of the subject. Thus, although land improvement by irrigation is only in part an engineering matter, it seems that engineers are more able, or more willing, than other kinds of men to face its problems squarely and discuss them free from the bias of partisanship. We have long held the view that the engineer's peculiarly impartial position gives him this advantage of unbiased and well-informed insight in the case of many problems of public concern that are only to a slight extent engineering problems. The Salt Lake meeting tends to confirm this view. It thereby also brings out in fresh relief a phase of the profession's community responsibilities.

Real Construction Statistics

CONSTRUCTION statistics, like all other statistics, must be reasonably accurate or they are a nuisance. At present there are half a dozen or more sets of construction figures. Sometimes they are called construction statistics, sometimes building statistics. Some sets cover the entire country, others a certain section of the country. Some are compilations of building permit values for a certain number of cities. Some are actual contracts, others are called contemplated projects. All of them are more or less widely circulated and quoted as authoritative. So often do these pseudo-statistics conflict with the statistics collected and published by this journal that it is deemed desirable that a warning be issued as to authentic construction statistics.

So far as we know, and we have been collecting building statistics for 25 years, there are only two sets of construction statistics in the United States that are the result of consistent, constant and country-wide reporting, the Dodge figures for building and the *Engineering News-Record* figures for all kinds of heavy construction. All other statistics are based on occasional reports from scattered sources, extrapolated widely to assume national and regular significance.

Engineering News-Record statistics of the construction industry cover all contracts meeting certain minimum costs. They include roads, bridges and sewers, as well as buildings. Whenever they are presented they are clearly explained. They measure weekly the volume of heavy construction. By this is meant projects of the following minimum costs: water-works and excavation, drainage and irrigation, $15,000; other public works, $25,000; industrial buildings, $40,000; commercial buildings, $150,000. The total last year was over two billions, of which nearly half was for construction other than buildings. For building construction alone, including small residential, the Dodge Company gives the best index. Their total for 1924 was 133,156 separate contracts totaling $4,481,807,000. It must be borne in mind, however, that even this huge amount is not the construction volume of the country. It is for buildings only, and it does not include Montana, Wyoming, Colorado, New Mexico, Arizona, Utah, Idaho, Washington, Oregon and California.

The *Engineering News-Record* reports are not claimed to be absolutely correct as to totals. Under the best possible system of reporting some contracts will be missed. But they are the result of regular reporting by trained men and they are consistent from month to month and from year to year, so they are comparable

and concordant within themselves. They are offered as the best possible indication of changing conditions in construction, which cannot be said of those statistics which are local in character and spasmodic in periodicity. A sample of such reporting is before us. "Construction statistics for the first six months of 1925 in contracts awarded," says the publicity release of a local trade paper, "show a marked falling off in value compared with the corresponding period for commitments announced last year. The actual figures for 1924 are $514,489,500, while for 1925, from Jan. 1 to June 30, inclusive, they are $360,056,300. Contemplated projects made public during the past six months number 3,024, to cost $330,357,400." Nothing is said as to whether this refers to the entire country or to some part of it. During this same period *Engineering News-Record* reported 4,582 engineering construction contracts worth $1,144,498,000. Of these, 1,999 were for large buildings. The Dodge Company reported for thirty-eight states a total of 84,314 building contracts to cost $2,750,000,000. Taking out residential construction, 21,890 contracts worth $1,533,000,000 remain. As for "contemplated projects," the total for buildings alone is nearer 100,000 than 3,024.

Figures don't lie, says the old saw, but the reverse doesn't hold.

New York Refuse on Jersey Shore

ALLEGATIONS and denials that the garbage and other floatable refuse of New York City is defiling the beaches of New Jersey coast resorts occupy the front pages of the New York metropolitan and the New Jersey dailies just now, as they have each summer for several years past and presumably will continue to do until New York City re-establishes an adequate system of municipal refuse disposal.

The dumping at sea practiced now for nearly eight years under the Hylan administration is confessedly a makeshift, however strenuously the mayor denies that it is New York garbage and refuse that abounds in the waters and litters the beaches at the Jersey coast resorts. The mayor urges that incinerators are being constructed as rapidly as possible. He does not say that, acting on pre-election promises, he caused the shutting down of an immense new garbage reduction plant, put in operation at the close of the previous city administration, without lifting a finger towards compelling an enlargement of it or changes in its method of operation, if either were needed. Instead of attempting adjustment of any kind, the plant was ordered closed, the substantial revenue due the city under the contract forfeited, and the city committed to material expense for sea dumping—under another contractor, of course. This has continued for well towards a decade and unless there is a material change in plan or at least in progress towards fulfillment, it will continue in large measure for several years more.

Meanwhile, neither the New Jersey complainants nor the New York defendants in the case, nor the War Department, which is supposed to see fair play to both sides and to have power to that end, seem to have done much towards establishing the facts in controversy, which might have been done long ago by proper engineering studies.

The mayor urges that the city's incinerator program has been delayed by opposition to the choice of sites. That he and his advisers would have known at the outset, had experience elsewhere been ascertained. There is no royal road to garbage disposal, whether the route or method be dumping at sea, or reduction or incineration on land, but with a sufficient expenditure of money and engineering brains either one of these methods may be so carried out as not to give cause for reasonable complaint.

Strength of Material

HOW strong is a given material? We have an inevitable tendency to think of each material in terms of one defining property; we speak of 75,000-lb. steel, for example, or 3,000-lb. concrete; yet when it comes to judging of the usefulness of the material for a specific service we doubt—and with good reason—whether the figure chosen as type standard is a correct indication of service value. It is even questionable whether for but a single kind of service a single figure is sufficient to express the resisting power of the material.

Special materials present the difficulties of the case most strikingly. For example, what is the resistance of a paint coating? It is the product of factors about which we know practically nothing and appear to be learning little more. We have no measure of paint resistance. Only enough is known that we can say, with fair certainty, that no one numerical characteristic of a paint is significant for all kinds of service, or even for any one kind of service—except that perhaps for some particular purpose price per gallon is a good criterion. Hence the expedient of making extensive, costly exposure or performance tests, of which many have been carried out in the past and many more will be undertaken in future. Hence also the constant demand for standardizing artificial service tests, and the recurring debates over correlation of artificial tests and actual service conditions.

That this state of affairs is of controlling importance in the field of materials of the type of rubber, paint and rust-resisting materials is obvious. But we are learning as time goes on that probably the same situation affects our more familiar and more typical test materials, like steel. The common strength figure, that of the tensile test, seems to be of limited value as a gage of service strength. Study of fatigue and of high temperature strength in recent times has brought out little evidence of any relation between these properties and ordinary tensile strength values and much evidence against any such relation. While the steel user naturally tries to refer each new service requirement to tensile strength, careful investigation usually shows that the attempt is mistaken. In one respect only does he continue to find justification for his faith in tensile strength—in the remarkable range of excellence displayed by steels of highest strength.

In general, the outlook is that, for steel as for other materials, dependable estimates of strength to resist any particular service will have to be based on special measurements without regard to the conventional test properties. The more we learn about materials the less correlation we discover between individual test properties. If such materials as steel or bronze possess a single defining characteristic it has not yet been discovered. So long as this remains the case, the strength of a material will have as many values as there are uses or conditions of use to be considered.

City of Washington Builds Nine-Mile Aqueduct

With New Rapid Sand Filter Plant, Covered Reservoirs and High Service Pipe Lines, Independent New Water Supply Is Provided National Capital

VIRTUALLY a second water-supply system for Washington, D. C., will be well toward completion with the end of the present year. In eighteen months it should be finished in all essential details. Completed it will comprise an aqueduct larger than the famous old structure of General Meigs; 80 m.g.d. filter plant, two covered reservoirs, a hydro-electric power plant, and various pressure pipe lines. Then the old works, built in Civil War times, except for the present filter plant and connection, can be closed down for the long desired renovation of tunnels and conduit not laid dry since they were built. Renewed, they will go back into service and the two plants will, it is estimated, give the metropolitan district of the national capital ample water supply until, in another generation perhaps, the population reaches a million.

FIG. 1—LOCATION MAP OF OLD AND NEW WATERWORKS FOR WASHINGTON

NEW STRUCTURES

(1) New Conduit
(2) Cabin John Siphon
(3) New Filtration Plant
(4) New Pumping Station
(5) Hydro-Electric Plant
(6) First High Reservoir
(7) Second High Reservoir
(8) First High Pipe Line
(9) Second High Pipe Line
(10) Third High Pipe Line
(11) Second High Tunnel

EXISTING STRUCTURES

(12) Great Falls Dam
(13) Old Conduit
(14) Cabin John Bridge
(15) Dalecarlia Reservoir
(16) Coagulating Plant
(17) Conduit to Georgetown Reservoir
(18) Georgetown Reservoir
(19) Reno Reservoir
(20) 16th St. Reservoir
(21) Washington City Tunnel
(22) McMillan Park Reservoir
(23) Filtration Plant Pumping Station
(24) McMillan Park Filtration Plant

A diagram map of the old and new works is given by Fig. 1. Of the new structures, the aqueduct is completed except one tunnel which is planned to be finished this year. The filter plant substructure is well under construction and so are the two new covered reservoirs and the first high pressure pipe line. All the other units remain to be put under contract. None of the construction so far is by day labor and it is intended to let contracts for all. The reservoirs and first pressure pipe line are likely to be completed in 1925 and the filters in 1926. Together the new plant and aqueduct form one of the larger water supply construction operations of present times. They involve an estimated expenditure of $9,000,000.

Aqueduct—Built in 1863 the old Washington aqueduct has been celebrated as one of the great engineering structures. As built it was 11 miles long of which 1.49 miles were unlined tunnel and the remainder was 9-ft. circular brick or rubble masonry cut and cover conduit. It was a flow-line aqueduct throughout and in line followed rather closely the contours of the Potomac River whose north bank provided a side-hill location. The Conduit Road, well known as a scenic drive west along the Potomac, is for the most part directly over the old aqueduct. This particular mention of the old aqueduct is made because the new aqueduct runs virtually parallel in line and grade from Great Falls to Dalecarlia as shown by Figs. 1 and 2.

It is noted that no new location or points of intake and outlet were selected for the new conduit. It is built closer to the river by some 20 to 30 ft. than the old Civil War aqueduct but its intake is from the pool of the old Great Falls dam and its outlet is the old Dalecarlia Reservoir built for the aqueduct of 1863. In design the new aqueduct is of three types: lined tunnel, plain concrete cut and cover flow line aqueduct, and reinforced-concrete pressure siphon. All three sections and the profile are shown by Fig. 2.

Compared with the old aqueduct the material is concrete, the tunnels are lined and the cut and cover section is the modern multi-centered acute-arch and shallow-invert type. The great difference, however, of the new conduit from the old is the inverted siphon for crossing the valley of Cabin John Creek. For the old aqueduct crossing one of the famous aqueduct bridges of the world, the Cabin John Arch, was built by Gen. M. C. Meigs. This gave a flow line aqueduct from intake to outlet.

Itemized the aqueduct structure comprises: (1) An intake chamber at Great Falls, (2) 43,835 ft. of cut and cover aqueduct between Great Falls and the Dalecarlia reservoir, (3) 2,400 ft. of tunnel at Great Falls,

(4) three cross-connections between the old and new conduits, (5) an inverted siphon at Cabin John Creek, (6) an 800-ft. tunnel through Dalecarlia hill to the reservoir, and (7) an influent gate house at Dalecarlia reservoir. Only the tunnels, the cut and cover aqueduct and the inverted siphon involved distinctive construction features.

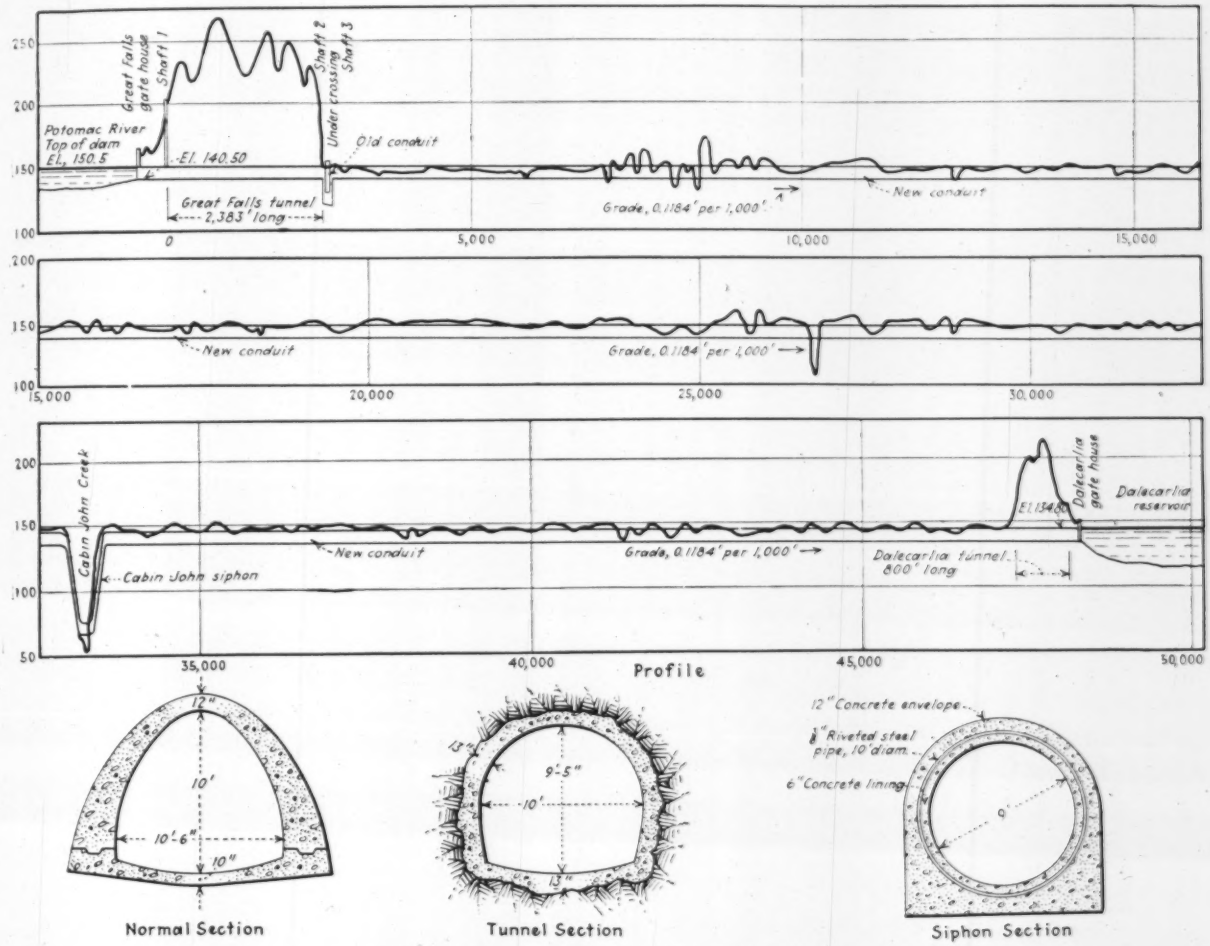


FIG. 2—PROFILE AND SECTIONS OF NINE-MILE MASONRY AQUEDUCT

The cut and cover aqueduct involved two general construction problems—access and hazard. The only route of access to the work almost from Great Falls to Dalecarlia is the old Conduit Road. This is a two-track road of bituminous construction of different types but all light. It had, however, the advantage of excellent drainage and a stable, load carrying subsoil. All materials came in from the Washington end. This put a heavy traffic on the eastern division as it had to pass through its own construction traffic all the haulage for the farther divisions. With different subcontractors on the three divisions there was congestion from poor co-ordination which handicapped progress. Often, too, construction plant and excavation limits encroached on the traffic way, as some of the pictures show.

Hazard came chiefly through the risk of trenching so near to the old aqueduct, at best only a three-ring brick structure. The excavation was largely in rock requiring blasting—sometimes solid rock but as often blocky or disintegrated rock subject to slides. The earth cut was a stiff combination of stone and dirt and invariably a steam shovel operation. Where the soil was more dangerous the trench wall next the old aqueduct was sheeted and braced. In many instances, however, the contractors played a rather bold game of taking chances in leaving out bracing. Only one break of the old conduit occurred during construction, however.

There were some differences in the outfits for concreting but generally a paving mixer, with chute, moved along the bank taking its proportioned batches from industrial railway cars or from motor trucks. Figs. 3, 4 and 5 indicate mixers and forms. The normal section of cut and cover conduit had a solid sectional area of 55.48 sq.ft., so that the concrete ran about 2 cu.yd. per foot. A 1:2:4 mixture mixed 1¼ minutes was used. Particular care in workmanship was required.

As shown by Fig. 3 the invert was concreted in alternate sections; these were generally 15 ft. long. The view shows the key ways. Similar key ways were provided in the ends of the arch sections which were of such length as could be concreted in a day. Besides the key ways each vertical joint had a ½-in. filler of "plastic cement" troweled on the finished end just before

the succeeding section was concreted. This filler was made of 20 per cent long-fiber asbestos and 80 per cent of tough asphaltic bitumen and was applied cold. The forms used are shown by Figs. 4 and 5, which also indicate the method of shifting. In placing concrete, besides the usual good workmanship requirements, particular attention was given to depositing it as close as possible to its final location and to preventing leakage of water from forms. Backfilling was accomplished as soon as practicable after the forms were removed.

Inverted Siphon—Two dictates ruled the selection of an inverted siphon to carry the new aqueduct across Cabin John Creek; it left the view of the old Cabin John Arch unobstructed and it was less expensive than any permanent bridge had the engineers felt free to construct a bridge. As the siphon was originally designed it was to pass under the creek bed and be buried in trench down the banks. This design left unchanged the natural opening under the arch. It unfortunately was considered hazardous. When excavation was begun for the siphon trench (Fig. 6 shows its proximity to the arch masonry) it was disclosed that one arch end was on solid rock and the other on fissured and blocky ledge. To cut deep through this ledge was considered too big a risk to assume as only a very slight movement might deface, if it did not more seriously damage, a mounmental structure. The plan was changed to shallow cuts down the banks and a crossing on piers above the creek as shown by Fig. 6.

The new plan reduced the dip of the siphon from 104 ft. to 75½ ft.; but it introduced an obstruction in the creek and the piers were designed to take the head of a flood overflowing the siphon with the under waterway obstructed. The section of the siphon is shown by Fig. 2. It is a ⅜-in. riveted steel pipe encased by and lined with concrete. The steel pipe was assembled and shipped in sections 35 ft. long. When these were connected up, the ends of the siphon were plugged and it was filled with water. The concrete casing was then placed using outside forms. When the casing had become strong the water was drained out and the lining was placed. No particular construction difficulties were encountered.

Tunnels—Tunnel driving exhibited its traditional uncertainties in a remarkable way both in the one at Great Falls and in that through Dalecarlia hill. In both locations the new tunnel is not far from that for the old aqueduct. These old tunnels were through hard tight rock and were left unlined. In both the new tunnels shaky and dangerous rock has been found.

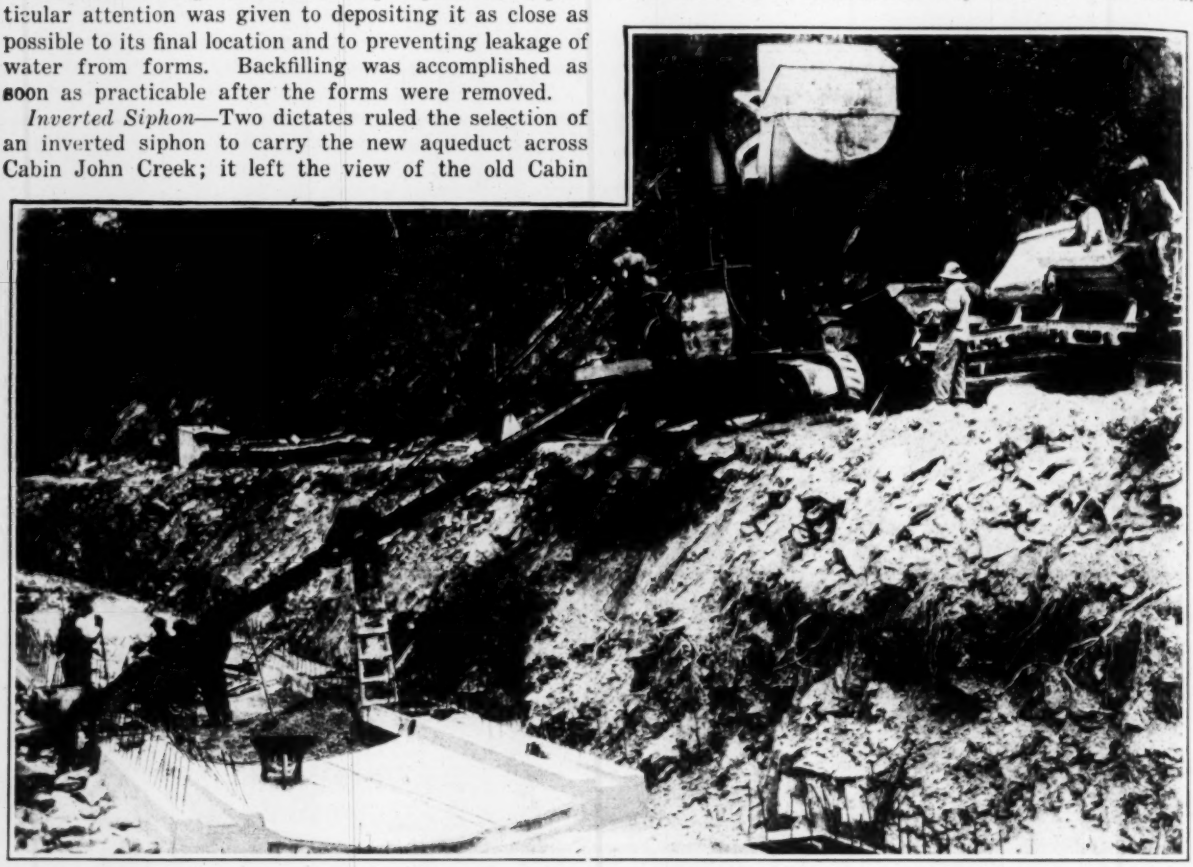


FIG. 3—CONCRETING INVERT WITH MIXER TRAVELING ALONG BANK

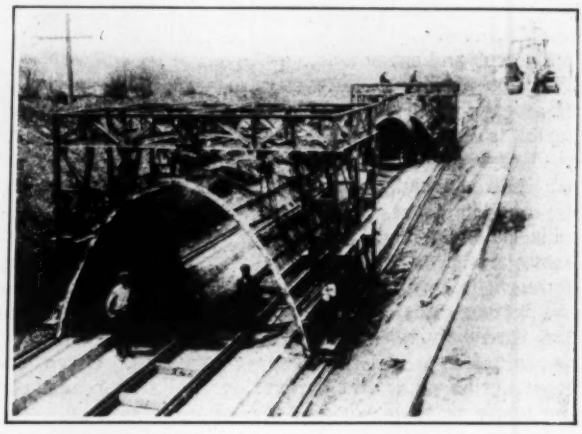


FIG. 4—STEEL FORM OUTFIT FOR CONDUIT ARCH CONSTRUCTION

Outside forms hung from gantry carriages which traveled on rails outside of invert slabs previously constructed as shown by Fig. 3.

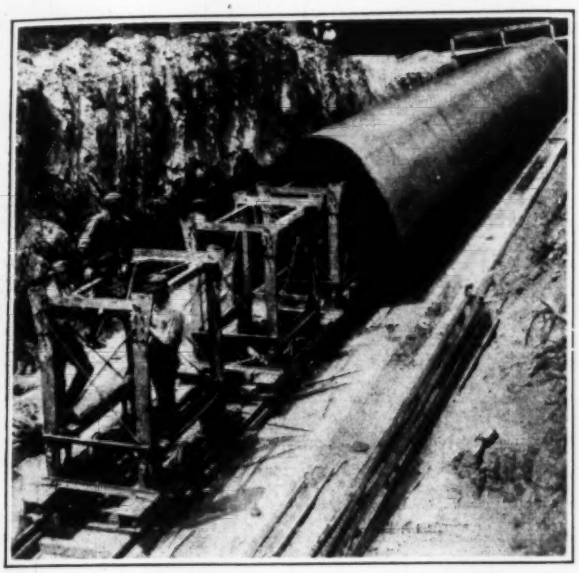


FIG. 5—INTERIOR FORM FOR CONDUIT ARCH
The forms are lifted and supported by carriages traveling on track, down center of invert. Note their position in place in the far form of Fig. 4.

The conditions at Great Falls were the worse and the action was remarkable. Here the rock is a "blue granite," which is hard as adamant but breaks true and close in tunneling to the trimming holes. For some 800 ft. in, the granite was solid and no difficulties beyond those of hard drilling were encountered. Then a blocky formation was struck and finally it caved. Here trouble began which cost the contractor an extra thirty thousand dollars to overcome.

After the first fall of blocky rock the inflowing material changed to rock fragments and earth. At the break the hill surface was about 130 ft. above the tunnel. The first plan of attack was to take out the material as it came in with the expectation that after a time the break would arch over. This did not happen. Finally the hill top began to sink in. and the pit enlarged and deepened as the earth was removed from the tunnel. A view of the crater when it was well advanced is given in Fig. 8. At the end it was 40 ft. across the top, funnel shaped and about 40 ft. deep. When it appeared that the inflow would not be stopped by arching, work was begun on drifting and timbering. This method put the hole through but it took heavy close timbering and slow, tedious excavation to accomplish the task. The bore is now completed and the tunnel is being lined.

FIG. 6 — INVERTED SIPHON ALONGSIDE CABIN JOHN ARCH
The 10-ft. steel pipe has been connected up and the concrete casing is being placed. The Cabin John Arch has a span of 220 ft. of granite masonry.

Filter Plant—Except in general, the design of the filter plant is not considered here. A plan of the plant showing the connecting structures and also the site conditions is given in Fig. 9. Briefly the new filtration plant will be of the rapid sand gravity type and will

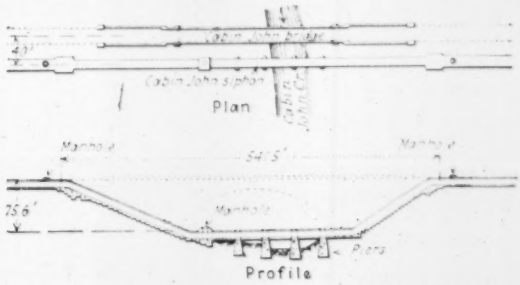


FIG. 7—PLAN AND PROFILE OF CABIN JOHN SIPHON

operate about 25 times as fast as the present slow sand type now in service at McMillan Park. This higher rate of filtration is obtained by thorough preliminary coagulation and settlement and by washing the filters at frequent intervals.

The operation of the new plant will be as follows: The unfiltered or raw water will leave Dalecarlia reservoir and will flow by gravity to the filtration plant by way of the new 6-ft. diameter branch conduit. The coagulant, sulphate of alumina, will be added at the new gatehouse. Entering the headhouse the treated water will pass through the control chambers to the mixing basins where a series of baffles will mix the coagulant

FIG. 8—CRATER IN HILL OVER GREAT FALLS TUNNEL
Slide into tunnel broke through surface 130 ft. above and formed a funnel shaped pit 40 ft. wide and deep.

thoroughly with the water. The water will then flow to the coagulating basins which will provide for a settling period of about 2 hours. Practically all the color and turbidity and a large percentage of the bacteria in the raw water will be removed in those basins. The water next flows by gravity to the filters. There are 20 of these filters and each filter will have a rated capacity of 4 m.g.d., giving a total capacity for the filter plant of 80 m.g.d. The filters will contain about 16 in. of gravel and 24 in. of fine sand. Washing the filters will be performed by reversing the flow by means of hydraulically operated valves allowing the dirty water to flow to waste. Washing intervals vary from 20 to 30 hours. Leaving the filters the water flows to the filtered water reservoir which provides for a storage of about 15 m.g. From this point the water will be pumped by motor-operated centrifugal pumps to the high service reservoirs.

The headhouse will be used for manufacturing the

sulphate of alumina. The raw materials used for this process are sulphuric acid and bauxite. The offices and chemical laboratories and heating plant will also be located in the headhouse.

Outstanding in this plan for mechanical filtration is the provision for hydro-electric power development. This is an economic feature made possible by local conditions. The new and old aqueducts can for years deliver much more water to Dalecarlia reservoir than can be used by the city. The reservoir level is approximately 140 ft. above the Potomac, and 1,500 ft. of penstock from the reservoir will deliver a 130-ft. head to turbines on the lower river bank as indicated by the filter plant plan, Fig. 9. This power put into electric current will do all the pumping from the filter plant to the two high level reservoirs and supply all other power requirements. No development of power beyond the requirements of the waterworks is contemplated.

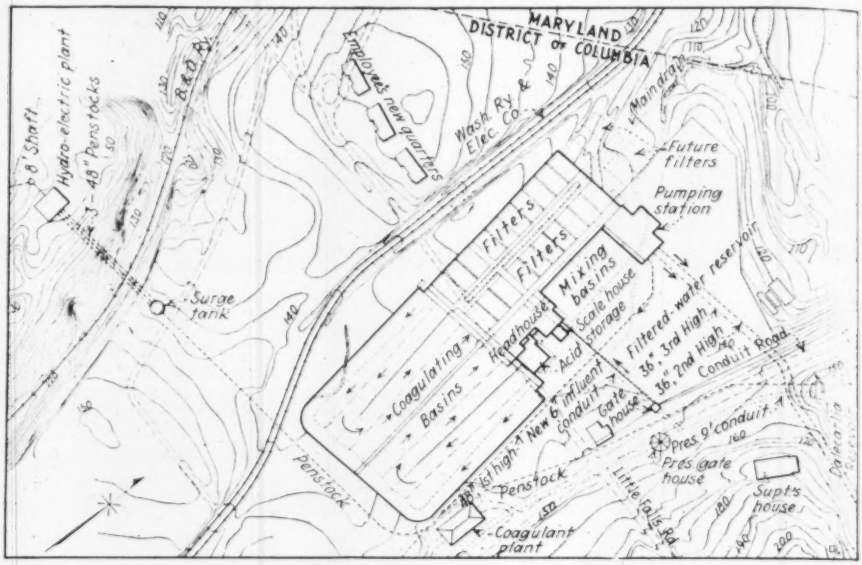


FIG. 9—PLAN OF FILTERS AND POWER PLANT
Surplus water delivered by new aqueduct operates hydro-electric plant furnishing power for pumping and filter operation.

As indicated there are three high pressure lines from the filter plant. Two of these go to the new high-pressure reservoirs located as indicated on Fig. 1. Only the first high pressure line has been put under construction. It is a jointed concrete pressure pipe and the contractor has put in a complete plant near the filter plant for pipe manufacture.

Construction of the filter plant substructure is chiefly a concrete placing task and the tower hoist and chuting system has been adopted. The tower and mixing plant are located just east of the headhouse and with 175 ft. hoist the chutes will reach virtually all but the coagulating basin work. There is no particular novelty in plant

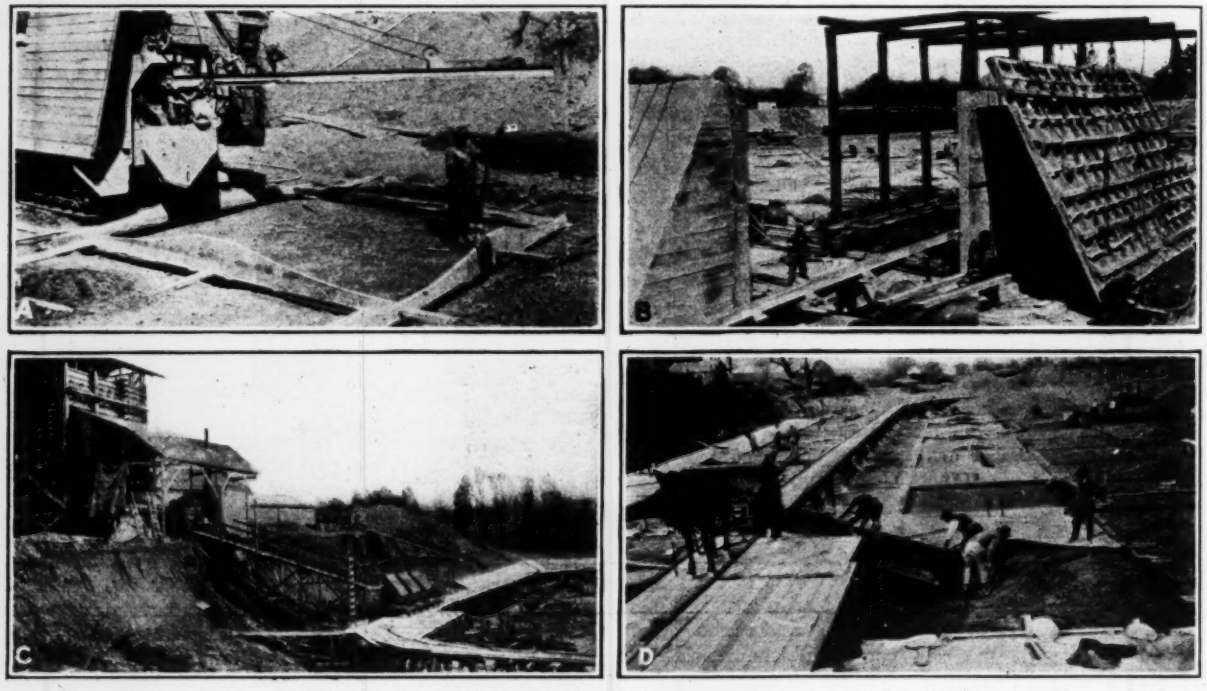


FIG. 10—CONSTRUCTION VIEWS OF HIGH SERVICE RESERVOIRS

A—Paving mixer places concrete for groined invert floor. B—Cantilever carriage handles heavy wall forms.
C—Mixer plant on bank delivers to industrial railway. D—Concreting floor inverts by dumping from industrial cars.

or methods. About 35,000 cu.yd. of concrete are being placed in a workmanlike manner by familiar plant and procedure.

Reservoirs—Both high pressure reservoirs are approximately rectangular concrete structures with gravity walls and groined-arch inverts and roofs. The first has 13,300 cu.yd. and the second 12,300 cu.yd. of concrete. The excavation, earth in both cases, is respectively, 75,000 cu.yd. and 65,000 cu.yd. Different contractors have the two structures and have developed likewise an interesting difference in concreting outfits for the floor and wall work which so far is all that has been done.

For the first reservoir floor a paving mixer is being used as shown by Fig. 10*A*. The proportioned batches are brought to the mixer in four compartment trucks. Excellent progress is being made by this method with an amazingly small force. Fig. 10*B* shows the traveling crane for handling wall forms. It is a job-built outfit moved on rollers. On the second reservoir the plant and procedure are radically different. A stationary mixing plant located on one bank as indicated by Fig 10*C* delivers by conveyor to cars on industrial track circling the reservoir inside. Fig. 10*D* shows a floor panel being concreted by dumping from the cars. For wall work and distant floor panels the cars dump onto a mounted conveyor belt.

Engineers and Contractors—Maj. James A. O'Connor is contracting officer for the new water supply and E. D. Hardy is associate engineer in general charge of design and construction. J. E. Curtis, R. O. Macqueen and C. E. Swift have immediate charge of construction in the field. The contractor for the aqueduct was the Arundel Corp., Baltimore, Md. Charles H. Tompkins Co., Washington, D. C., has the contract for the filter plant substructure. The contractors for the first and second reservoirs respectively are: M. I. O'Connor, Northampton, Mass., and Parsons & Hyman, Inc., Washington, D. C. The Lock-Joint Pipe Co., Ampere, N. J., is the contractor for the first high pressure line.

Storage to Solve Fire Reserve Problem

Extract from Paper by Charles W. Parsons, Engineer, Illinois Inspection Bureau, Presented March 18 to the Illinois Section of the American Water Works Association.

FACTORS which point to adequate storage as a practical and economical solution of the fire reserve problems in the smaller cities are as follows: A certain quantity of water is needed for a moderate number of hours to protect the lives and the property of the citizens of any city from destruction by fire. This necessary fire flow is much greater than the maximum rate of domestic consumption and becomes many times the domestic rate in the smaller municipalities. Where a sufficient supply of potable water is not readily available for maintaining this desired rate of fire flow, the cost of drilling sufficient additional wells or of constructing reserve filter capacity to equal from 5 to 35 times the domestic rate generally would be a financial impossibility. It is the aim of every city to provide the maximum possible protection as a safeguard against disaster by fire.

The water-supply works should be developed to their maximum economical limit. The difference between the normal rate of yield of these works and the rate of flow necessary for efficient fire fighting can usually be provided most economically by adequate storage. Such storage should be of sufficient size and number to deliver the desired quantities to the various localities requiring protection. Where natural elevations are not available for reservoirs, a tank of substantial capacity on a tower of sufficient height will be a most valuable asset to economical operation and a real safeguard against interruption of service. The remaining portion of the desired rate of fire flow can then be provided most economically by reserve pumps drawing from a sufficiently large suction storage reservoir. It is in providing this storage that designing engineers and water superintendents have one of the greatest opportunities materially to increase the adequacy and the reliability of the water-works of the smaller American cities.

Great Salt Lake Desert Survey to Be Undertaken

THE Great Salt Lake Desert in Utah, covering many square miles and one of the largest areas included in the public domain of the United States remaining unsurveyed, is going to be the subject of exploration by the government. The U. S. Geological Survey is planning to make extensive investigations of the saline deposits in the entire area. Tracts of land found containing valuable salts will be designated and classified. The General Land Office through its government surveyors will undertake the running over the entire desert of the Salt Lake base line, first standard parallels North and South, the third guide meridian West and such other controlling lines of the public land survey system as are deemed necessary.

Because of the saline and salts deposits throughout the area the surveyors will be compelled to use wooden posts or suitable material to mark the course of these lines across the desert. Should the regulation iron posts be used as markers in the survey, it is believed that they would soon be corroded.

The general Land Office has also under consideration the survey of an area of land of some 20,000 acres bordering the northern shore of Great Salt Lake in Utah.

The land is in the vicinity of Bear River Bay, into which is discharged the principal affluent of the lake, Bear River, and includes the delta at the mouth of that stream. Since the construction of the Ogden-Lucin cutoff of the Southern Pacific R.R., the waters of the bay have become fresh.

This land has come into existence since the early surveys by the recession of the waters of the lake. It is shown in the preliminary investigation that the lake level is quite variable in different years and at different seasons of the same year and that it rises or recedes through periods or cycles of years, due to the recurrence of wet or dry seasons. With reference to this subject the investigation determined that from the years 1852 to 1855 the lake rose approximately 4 ft.; from 1856 to 1861 it lowered approximately 5 ft.; from 1863 to 1868 it rose approximately 11½ ft. where it remained until 1874, and during this period it reached the highest level recorded. From 1874 to 1905 the statistics show a lowering of the level of about 16 ft. and it was this period that caused the belief that the Great Salt Lake was gradually drying up, but from 1905 to 1910 it rose about 8 ft. to a level which is approximately that of the present time.

In the vicinity of Bear River Bay the slope of the shore is very gradual and a slight rise or fall of the water level will uncover or submerge large areas of land and the same result follows when the wind blows a day or two from one direction.

New Route for Arterial Road from Holland Tunnel

Old Route Met Objections from New Jersey Board of Commerce and Navigation—Tunnels Substituted for Bridges

CHANGE in route between Jersey City and Newark of the arterial road to distribute west the traffic of the Holland vehicular tunnel across the Hudson River from New York City is recommended in a report made to the New Jersey Board of Commerce and Navigation by its director, Victor Gelineau, and Charles W. Staniford, consulting engineer. Bridge crossings of the Passaic and Hackensack Rivers are also condemned and tunnels are advocated. General plans for the arterial road as tentatively laid down by the New Jersey Highway Commission were described in *Engineering News-Record*, April 30, 1925, p. 731. The accompanying map shows this original route and the proposed new route for the section under consideration. The report, condensed, is as follows:

The section of this route to be considered for tunnel development extends from a point on the west side of Jersey City Heights to a point in Newark just west of the Passaic River. Between these points the Highway Commission has planned a straight line, crossing the Hackensack River on a bad angle for navigation, and crossing the Passaic River in a very bad location on account of its nearness to the present Lincoln Highway bridge.

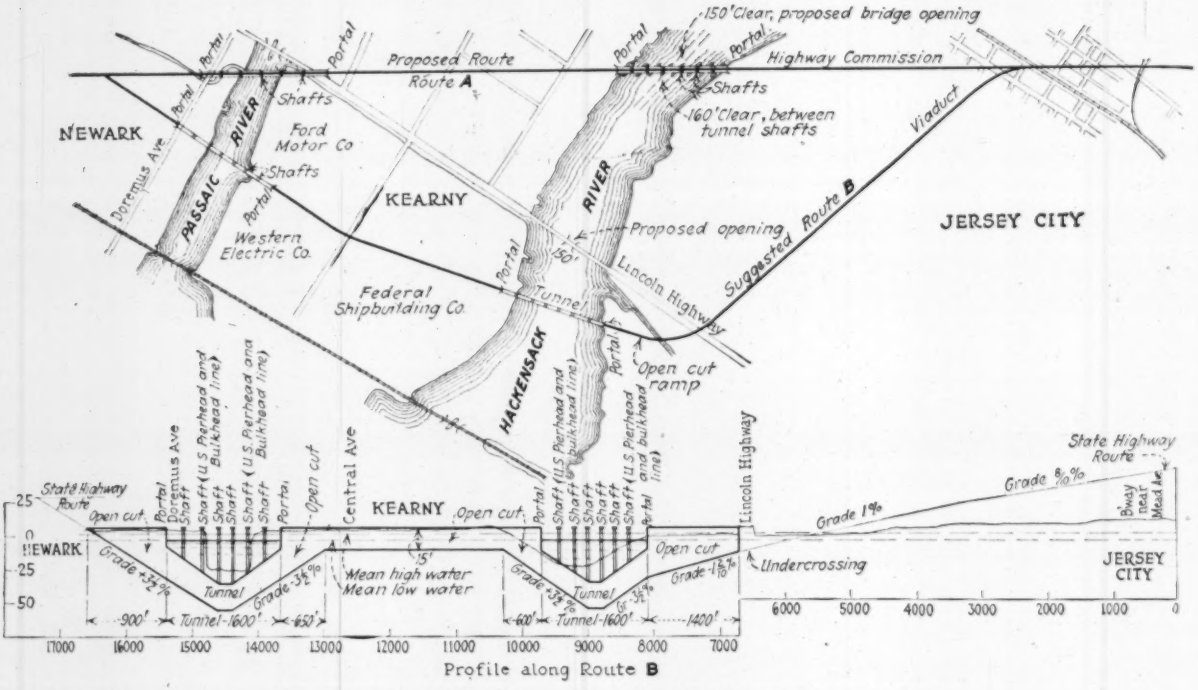
The nearness of the proposed bridge to the Lincoln Highway bridge, which is at a low level, decreases the usefulness of the 35-ft. high level assumed for the new bridge. Simultaneous openings will usually be required.

If it is absolutely essential that this new highway shall be built on a straight line between the points mentioned, the location for a tunnel is shown on the accompanying map called Route A Highway Commission. It also shows the location of the bridge piers proposed for the highway as compared with the shafts which would be necessary for the tunnel.

Suggested Route—An alternative route for tunnel construction is suggested for comparison, the reasons for its adoption being the possibility of placing the tunnel about midway between the two bridges across the Passaic, and approximately between the Western Electric and Ford properties normal with the general line of streets and structures. In the same way a more normal crossing of the Hackensack River is obtained. The distance between the two points noted on the straight line of the Highway Commission is about 14,450 ft., while the distance along proposed Route B is about 16,800 ft., or an increase over the Highway Department Line of about 2350 ft.

Tunnel Construction—The 3½ per cent grade assumed for tunnel approach renders tunnel crossings with shallow depths feasible. This, together with the quality of material met, namely, mud and sand, renders open trench excavation inexpensive, therefore the tunneling method proposed is to dredge out by open trench pumping much of this top material, sheetpile the trench and sink the tunnel in sections into it. The sections of tunnel between shafts to be built on launching ways at some place on the shore, launched, then towed into place and sunk into the prepared submerged trench.

It is estimated that the section from the easterly approach of the Hackensack River tunnel westerly including the Hackensack River tunnel, the depression between the two rivers, the Passaic River tunnel to the westerly end of said tunnel, will cost $10,000,000.



PLANS FOR HOLLAND TUNNEL ROAD ACROSS HACKENSACK MEADOWS

Prohibit Breeding Ground for Marine Borers

The menace to wood piling arising from a nearby breeding ground for marine borers is considered of such importance in Los Angeles harbor that the board of harbor commissioners at that port has prohibited the use of untreated piling anywhere within the limits of the harbor. This is believed to be a factor in obtaining longer life in creosoted piling which is liable to abrasion or defects that borers would be more likely to find if they were present in large numbers.

Engineering in the Small City

A series of notes from the field on the Problems and Practices of the Municipal Engineer in the Cities Below 100,000

The Editor Visits the City Engineer

Snapshots of Our Representative Small Cities

Annapolis, Md.

U.S. NAVAL ACADEMY, ANNAPOLIS, MD

CAPITAL OF MARYLAND AND COUNTY SEAT of Anne Arundel County. Situated on the Severn River, 2 miles from Chesapeake Bay. Most noted institution is U. S. Naval Academy and naval experiment station. City has fine harbor and extensive oyster-canning industry. In 1608 was visited by Captain John Smith, in 1649 settled by Puritans from Virginia; first name was Providence, name changed several times, finally Town of Annapolis in honor of Queen Anne. Became capital of Maryland Province in 1694. Pop. (est. 1924) 12,000.

ANNAPOLIS is a city without an engineer, but not without engineering service. There is not an engineer in any of the city departments, and all services are administered by laymen. But these laymen, one the city commissioner practically in direct charge of sewer and street maintenance and garbage disposal and street cleaning, and the head of the water board, have great respect for professional advice, though they seek it only under stress of conditions. Neither the city commissioner, William H. Vansant, nor the president of the water board, William H. Moss, arrogates to himself an iota of technical knowledge. In fact both are superlatively repetitive in their acknowledgment of lack of engineering information. No city engineer is employed because of the expense and small amount of work. Whenever engineering supervision is needed the city hires it, and it has done so frequently. However, all of the money paid out for technical services has not equaled even a moderate salary which would have to be paid a regular engineering officer.

This state of affairs, considered superficially, raises a lot of questions in the minds of those most conversant with engineering administration of small municipalities. For instance, how is the water supply administered? Who designs and constructs new streets, or resurfaces and patches old ones? Who is technically responsible for installing new sewerage facilities? How are garbage disposal and street cleaning cared for without the creation of a public nuisance? Before going into these details let us first look at the organization of municipal services.

The city administration is composed of a mayor, council, aldermen, a city commissioner, counselor, treasurer, health officer, market master, chief of police and fire marshal. The city council contains various committees, of which only the committee on streets concerns the present discussion. That body has referred to it all matters concerning streets, which include sewers, paving, street cleaning and garbage disposal. The city commissioner, however, carries out the routine and only where controversial matters arise does the street committee of the council take a hand.

The water system of the city is owned by the city and is administered by a board appointed as follows: the mayor and counselor are members by virtue of their offices; the mayor appoints the president of the board who is the third member; the council appoints two, one of whom must represent the minority political party in the council.

The present president of the water board, or the Annapolis Water Co., as it is officially called, though a layman, has taken extreme interest in water supply. The history of the plant and details of possible future extensions are on the tip of his tongue. The supply is taken from Broad Creek, in a watershed all of which the city owns and which represents about one-third of the drainage area of the stream and its tributaries. The supply is impounded by a reinforced-concrete dam, completed only last year after the earth dam, previously storing the water for many years, had been taken out by a freshet. Water is led into a sedimentation basin below the dam, then into a clear water basin and on again to the reservoir with a capacity of about 7 m.g. The average consumption is between 1 and 1.5 m.g.d. and the system, a gravity one, supplies water at a pressure ranging from 20 to 50 lb. in the mains.

There has been much controversy between the city and the state department of health over turbidity and bacterial content, and the state has been active in its endeavor to get the city to filter the water. The city, however, maintained that turbidity was noticeable only during the time water had to be pumped practically from the stream after the earth dam had washed out and before the concrete one was installed. After freshets Mr. Moss avers that some turbidity is noticeable owing to the necessity for taking water from the settling basin during periods of maximum pumping. Recommendation was therefore made to the state department of health that a bypass canal be run from the stream to the clear-water reservoir for use after rains, as the stream water clears within a few hours. The state department of health has made tests showing a turbidity in the streams of only 7 p.p.m. Filtration is still being considered, so thus far the city's recommendation for a bypass canal has received no action.

The financial condition of the water company is excellent, and as this is true on the basis of its present plant, there will be a strong disposition on the part of the water board to resist any expensive installations, unless required by sanitary conditions. Several consultants have been called from time to time to report on the condition of the water and plan future extensions. Nicholas S. Hill, Jr., of New York City, is doing most of the consulting work at the present time.

The city of Annapolis lies practically on a hill with the capitol occupying the highest point. From that building the slope is in every direction toward water, with the exception of about one-sixth of the periphery of the city. This topography has made sewage disposal simple but not entirely sanitary. It means that at the foot of practically every street is an outlet into either

the Severn River, Chesapeake Bay or an arm of one of these waters. Such outlets even discharge into the river through the bulkhead fronting the Naval Academy grounds. Sooner or later better disposal will have to be made, but the expense will be heavy and must be borne by the U. S. Government, the state and the city. Sewers, under the present system, need little attention and whenever cleaning is thought necessary the city commissioner has it "done by a plumber who bills me for it."

Though the city has done considerable new paving within the past year, engineering design and supervision of construction have been furnished either by the state or county. Last year new vitrified brick paving amounting to some $74,000 was laid. The Maryland State Roads Commission furnished engineering from its district office and the city paid a legal engineering fee. New sewer installations are made in the same way. The state department of health supervises the design. Some small installations were recently designed and laid by a Naval Academy employee who did the work outside his regular hours. The city even has to get a permit from the state department of health to lay a sewer pipe.

If street patching is necessary the city commissioner tells a local mason what is to be done and he does it under the watchful eye of the city commissioner. Were extensive patching necessary, and were it done in such a fashion, the results might be disastrous. But extensive work is always put into more competent hands.

Garbage is collected daily, by contract. The city pays about $8,000 yearly for disposal, and garbage is dumped just outside the city limits on city property. No attempt is made to cover it. During the winter months it has been dumped within the city to fill a swamp into which a sewer had formerly discharged, and which was becoming a public nuisance. It is questionable whether dumping the garbage there is much of an improvement.

Inasmuch as the city commissioner has been in office for some time and has nothing else to do he has given a great deal of time to the personal supervision of street cleaning. Before the principal streets had been paved the entire width of streets had to be swept. Now, however, Mr. Vansant maintains that all that is necessary is to sweep the gutters. Automobile traffic in the city is heavy and the streets are narrow, their width between curbs averaging 40 ft. Traffic has been found to fan most of the litter into the gutters. As so many of the streets are on curves and the traffic heavy the contention is reasonable. With cleaning reduced to a minimum the only force necessary is four hand sweepers and one pickup wagon. The sweepers work all day and every day and are paid but $18 a week, a figure Mr. Vansant has been able to secure for them after years of pleading before an ultra-economical council. The pickup wagon is hired under contract which amounts to about $4 per day. Despite this apparent small force the cleanliness of the streets is one of the first things a visitor notices.

Municipal Quarry Costs at Rockford, Ill.

The city of Rockford in 1924 opened up an old limestone quarry crusher plant to furnish broken stone for street work. From April 16 to Dec. 3, 1924, 19,160 cu.yd. were crushed at a total cost of 83.9c. per cubic yard made up as follows: Labor, 54.2c.; maintenance, 8.1c.; supplies, such as dynamite, caps, fuse and oil, 5.4c.; stripping, 0.8c.; electric power, 3.0c.; operating Fordson tractor-hauled loader, 2.4c.; depreciation, 10c.

Engineering Work

Pavement Cutting Permits Protect City Against Loss

Reading, Pa., Requires Deposit of $4 to $10 Per Square Yard Depending on Type—Rigid Inspection Followed

IN THE city of Reading, Pa., a great deal of care is exercised in protecting the city from financial loss through private cutting of pavements for subsurface installations. Such care also insures proper backfilling and pavement repair and has a decided effect in prolonging pavement life.

An application is made to the Bureau of Highways, through the Bureau of Permits and Records, which must give in detail the name of the owner or authorized agent, his address, the name of the contractor who is to do the work, explicit information as to what the work comprises, the exact location of the proposed cutting and the purpose for which it is to be made. Permits are granted subject to conditions which impose a time limit set for completion of the work and other conditions covering method of excavation, backfilling, planking, and final restoration.

The following are rates of deposit per square yard: Class A (wood block), $10; Class B (brick, asphalt, hot mix, granite block and concrete), $8; Class C bituminous macadam), $6; and Class C (waterbound macadam and miscellaneous unimproved streets), $4.

Upon completion of the work, the permittee furnishes the superintendent of the Department of Streets and Public Improvements completely dimensioned plans indicating accurately the size, shape and kind of structure put in and its location with reference to the street surface of the nearest curb line and curb intersection. The work must be so conducted as not to interfere with water mains, sewers or their connections with houses until permission of the proper authorities is obtained. No excavation can be made within 4 ft. of the trunk of any tree without the approval of the superintendent of the Department of Streets and Public Improvements. No tunneling is allowed except by special permission from the bureau.

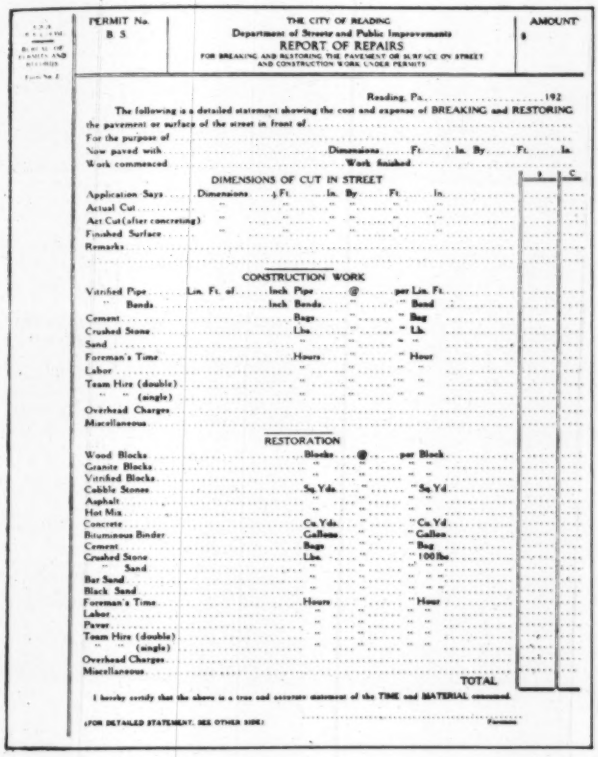
The applicant must further agree to backfill the excavation completely and to replace as great a portion as possible of the material excavated, compacting it by flushing, tamping or other suitable means. Whenever the city's inspector deems the excess material needed is unsatisfactory for backfill and the superintendent of the Department of Streets and Public Improvements has concurred in his decision, the applicant must backfill the trench with sand or other proper material acceptably compacted as required. Excess unsuitable material must be disposed of. Method of tamping is also explicitly designated, it being required that backfill be placed in layers not exceeding 3 in. in thickness, moistened, and each layer energetically tamped until thoroughly compacted.

Upon completion of the backfilling the applicant must lay in the cut, flush with the pavement surface, temporary planking of suitable thickness and quality, securely fastened together, or other material satisfactory to the superintendent of Streets and Public Im-

Of the Small City

provements, which includes hard coal cinders, wet and heavily tamped.

In order to secure a proper bond and to prevent settlement, the city, when finally restoring the pavement, removes the concrete base from the space at least 6 in. beyond all sides of the maximum area of earth disturbed so as to provide a firm bearing for the new concrete on the earth of the undisturbed margin of the trench. The concrete is beveled at least 3 in. outward



PERMIT No. B. S. — THE CITY OF READING — Department of Streets and Public Improvements — REPORT OF REPAIRS — FOR BREAKING AND RESTORING THE PAVEMENT OR SURFACE ON STREET AND CONSTRUCTION WORK UNDER PERMITS — AMOUNT $

Reading, Pa. 192

The following is a detailed statement showing the cost and expense of BREAKING and RESTORING the pavement or surface of the street in front of .....

For the purpose of .....

Now paved with ..... Dimensions ..... Ft. ..... In. By ..... Ft. ..... In.

Work commenced ..... Work finished .....

DIMENSIONS OF CUT IN STREET

Application Says	Dimensions	Ft.	In.	By	Ft.	In.					
Actual Cut	"	"	"	"	"	"					
Act Cut (after concreting)	"	"	"	"	"	"					
Finished Surface	"	"	"	"	"	"					
Remarks											

CONSTRUCTION WORK

Vitrified Pipe	Lin. Ft. of		Inch Pipe	@		per Lin. Ft.					
" Bends			Inch Bends	"		" Bend					
Cement			Bags	"		" Bag					
Crushed Stone			Lbs.	"		" Lb.					
Sand			"	"		"					
Foreman's Time			Hours	"		" Hour					
Labor			"	"		"					
Team Hire (double)			"	"		"					
" " (single)			"	"		"					
Overhead Charges											
Miscellaneous											

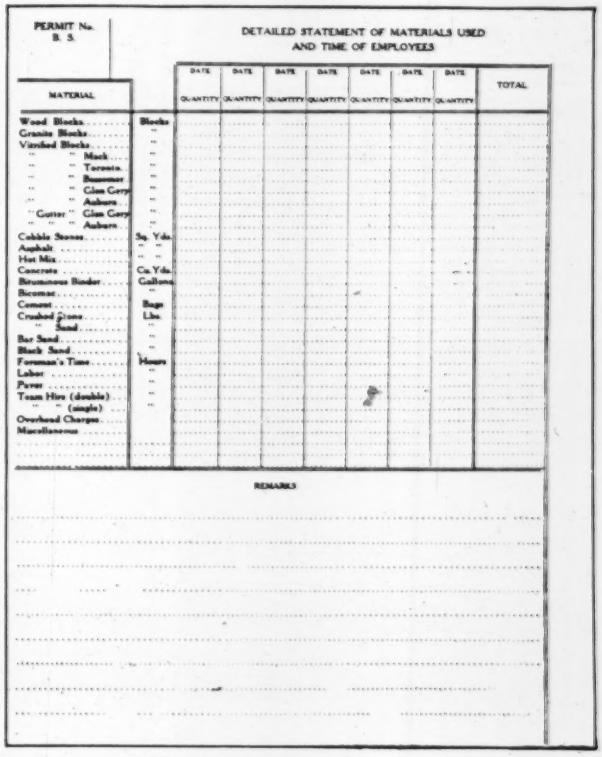
RESTORATION

Wood Blocks			Blocks	@		per Block					
Granite Blocks			"	"		"					
Vitrified Blocks			"	"		"					
Cobble Stones			Sq. Yds.	"		" Sq. Yd.					
Asphalt			"	"		"					
Hot Mix			"	"		"					
Concrete			Cu. Yds.	"		" Cu. Yd.					
Bituminous Binder			Gallons	"		" Gallon					
Cement			Bags	"		" Bag					
Crushed Stone			Lbs.	"		" 100 lbs.					
" Sand			"	"		"					
Bar Sand			"	"		"					
Black Sand			"	"		"					
Foreman's Time			Hours	"		" Hour					
Labor			"	"		"					
Paver			"	"		"					
Team Hire (double)			"	"		"					
" " (single)			"	"		"					
Overhead Charges											
Miscellaneous											

TOTAL

I hereby certify that the above is a true and accurate statement of the TIME and MATERIAL consumed.

(FOR DETAILED STATEMENT, SEE OTHER SIDE) ..... Foreman



PERMIT No. B. S. — DETAILED STATEMENT OF MATERIALS USED AND TIME OF EMPLOYEES

MATERIAL		DATE / QUANTITY	DATE / QUANTITY	DATE / QUANTITY	DATE / QUANTITY	DATE / QUANTITY	DATE / QUANTITY	DATE / QUANTITY	TOTAL
Wood Blocks	Blocks								
Granite Blocks	"								
Vitrified Blocks	"								
" " Mack	"								
" " Toronto	"								
" " Bessemer	"								
" " Glen Cove	"								
" " Auburn	"								
" Gutter " Glen Cove	"								
" " Auburn	"								
Cobble Stones	Sq. Yds.								
Asphalt	"								
Hot Mix	"								
Concrete	Cu. Yds.								
Bituminous Binder	Gallons								
Bicomac	"								
Cement	Bags								
Crushed Stone	Lbs.								
" Sand	"								
Bar Sand	"								
Black Sand	"								
Foreman's Time	Hours								
Labor	"								
Paver	"								
Team Hire (double)	"								
" " (single)	"								
Overhead Charges									
Miscellaneous									

REMARKS

REPORT OF STREET TRENCH CUTTING REPAIRS IN THE CITY OF READING, PA.

at the top and the wearing surface of the pavement replaced over an area extending at least 3 in. on all sides of the area of the new concrete. The placement of concrete base and pavement wearing surface is always made by the city's engineering forces, thus insuring uniformity of patching. Should the restoration work cost less than the amount stated in the application and no necessary subsequent replacement is involved, any balance left after restoration is paid to the applicant. He is billed for expense exceeding his deposit made with the application.

The same rigid regulations govern private cutting of curbs or sidewalks. To cut or reset any curb, application must be made to the superintendent of the Department of Streets and Public Improvements. The following fees have been decided upon: for curb line not exceeding 45 ft., $2; over 45 and not exceeding 100 ft. $3; over 100 ft. and not exceeding 300 ft., $4, and curb line exceeding 300 ft., $5. All work pertaining to excavation for vaults, sidewalks, areaways must be started within five days after the permit has been granted. A permit must be secured for cutting sidewalk at the rate of $1 per cut. For paving or repaving sidewalks a permit must be secured but no fee is charged unless it is necessary for the applicant to take out a permit for curb setting.

In the case of trenching work after the subsurface installation has been made, proper backfilling has been done and planks laid over the excavation, at the expiration of five months an inspection is made of the backfill cut and the foreman from the city engineering department then makes what repairs are necessary. If the backfilling has not been done properly or if the base has been done poorly, the man who has done the cutting pays for it. It has been found that the deposits made almost always cover the entire cost of repairs. In all such trenching work the city engineer takes the figures of the permittee on the yardage to be uncovered.

Cost of Cleaning Catch Basins

In May the average cost of cleaning catch basins in Rockford, Ill., with a vacuum cleaner was $1.56 each for 263 basins. The cleaner operated 140 hours removing 329 yd. The 304 gal. of gasoline and 68 pints of oil cost $55.97 and $4.08 respectively. Other segregated costs for the month shown in the report of the city engineer, B. E. Harvey, are as follows: Operator, $91, repairs, $37.69. laborers, $84, and depreciation including interest, $140.

Datum Planes—Their Determination for Engineering Uses

A Study of the Variations in Sea Level—Primary Sea Level Determinations—High Water and Low Water Planes—Subsidence of the Coast

By H. A. Marmer
U. S. Coast and Geodetic Survey, Washington, D. C.

THE difficulty of recovering the arbitrary datum planes used in old surveys has gradually led the engineer to the adoption of datum planes which may be readily recovered even though all bench mark connection be lost. Of such datum planes those based on the tides have been adopted by the engineering services of the government, and are being adopted by the engineering profession generally, as best meeting the requirements of a rational datum plane.

The Universal Datum Plane—Mean sea level, which may be defined as the surface the sea would assume when undisturbed by the rise and fall of the tide, is a datum plane which everywhere has the same definition. For engineering purposes mean sea level along the coast may be assumed to constitute an equipotential surface, and hence all surveys based on this datum are directly comparable. This characteristic of the plane of mean sea level constitutes it the universal datum plane.

With reference to bench marks on the coast, mean sea level may be determined by averaging, over a considerable period of time, the height of the tide as read hourly on a fixed staff graduated to feet and tenths, the zero of which has been connected with the bench marks by leveling. This is best accomplished by the use of an automatic tide gage which records the rise and fall of the tide in the form of a continuous curve. From this curve the hourly heights of the tide are easily tabulated.

Variations in Sea Level—Obviously, mean sea level determined from one day of tidal observations may be in error by a considerable amount. For altogether apart from any unusual weather conditions that may prevail, the rise and fall of the tide introduces a variation in sea level from day to day. Without going into detail regarding the tides, it may be stated that the tide as observed at any point is made up of a number of simple tides having various periods. The average length of the tidal day is 24 hours and 50 minutes, but there are several simple tides that have periods from half a month to a year. Table I shows the variation of mean sea level from day to day at Fort Hamilton in New York Harbor for the month of June, 1919—a typical summer month. In this table the values of sea level are derived by averaging the 24 hourly heights of each day, these heights being referred to a fixed tide staff.

TABLE I—SEA LEVEL, FORT HAMILTON: DAILY MEANS, JUNE, 1919

Date	Ft.	Date	Ft.	Date	Ft.
1	6.66	11	6.23	21	6.24
2	6.56	12	6.33	22	6.29
3	6.46	13	6.34	23	6.32
4	6.31	14	6.44	24	6.25
5	6.53	15	6.38	25	6.27
6	6.31	16	6.43	26	6.43
7	6.30	17	6.44	27	6.31
8	6.89	18	6.39	28	6.79
9	6.84	19	6.25	29	6.78
10	6.41	20	6.00	30	6.23

It will be observed that even during a summer month when meteorological conditions are relatively uniform, sea level varies from day to day as much as half a foot. But from month to month, too, sea level varies as may be seen from Table II, in which the heights of mean sea level for each month of 1919 at Fort Hamilton are given.

Between the greatest and least values of the monthly sea level shown in Table II, there is a difference of 0.81 ft. We must therefore conclude that sea level as determined from a month of tidal observations in subject to serious error. But it is of interest to note that the variation from month to month is not altogether haphazard. Observations show that in New York Harbor sea level is lowest in winter, generally in February, and highest in summer, generally in August. For any one year, wind and weather may distort somewhat the regularity of the variation from month to month, but this monthly variation is apparent in Table II; and in Fig. 1 it is shown as it appears from the whole series of observations at Fort Hamilton, covering a period of 30 years.

TABLE II—SEA LEVEL FORT HAMILTON: MONTHLY MEANS, 1919

Month	Ft.	Month	Ft.	Month	Ft.	Month	Ft.
Jan.	5.72	Apr.	6.10	July	6.28	Oct.	6.45
Feb.	5.88	May	6.43	Aug.	6.53	Nov.	6.49
Mar.	6.04	June	6.41	Sept.	6.37	Dec.	5.93

Not only does sea level vary from day to day and from month to month, but even from year to year there is some slight variation. From thirty years of observations it is found that mean sea level on the staff at Fort Hamilton reads 6 ft. This is adopted as the best determination of the plane of mean sea level. The variation from year to year with respect to this average value of 6 ft. is shown in Fig. 2.

Mean sea level determined from a year of tidal observations in New York Harbor may therefore be as much as 0.2 ft. in error, and the values from different years may differ by very nearly 0.4 ft. In themselves these quantities are relatively small, but in the determination of a primary datum for elevations, and in particular for precise leveling, such discrepancies are too great to be overlooked.

Primary Sea Level Determination—The variation in sea level from year to year makes necessary a long continued series of tidal observations at one or more points along any coast for the primary sea level determination. In a period of approximately nineteen years several of the long-period tidal variations will have gone through complete cycles, and it is therefore customary to regard the value of sea level based on a nineteen-year series as constituting a primary mean sea level determination.

For the control of its hydrographic work and in connection with its tidal work the Coast and Geodetic Survey maintains about fifteen principal tidal stations on the Atlantic, Gulf and Pacific coasts of the United States. Each of these principal tidal stations is located at some important port in which the rise and fall of the tide is representative of a considerable region. The re-

sults from these stations thus furnish the data for the primary determinations of sea level at a number of points along the coast, these being used as the tie-in points for the precise leveling that carries the plane of mean sea level into the interior of the country.

Secondary Sea Level Determination—At most places along the coast where it is desired to establish a sea level datum, a short series of tidal observations may be used and the resulting value corrected by comparison with a simultaneous series at the nearest principal station. Such secondary determinations of sea level are sufficiently accurate for all engineering purposes. A series of tidal observations three years in length will, when corrected by comparison with the results at a principal station, determine sea level within 0.02 ft.; observations covering a period of a year will determine it to 0.05 ft. and a month of observations may be taken to determine it within 0.10 ft.

To illustrate the method employed and the accuracy attained with one month of observations, we may use the observations at Atlantic City where mean sea level based on a series nine years in length reads 6.58 ft. on staff. Suppose now that but one month of observations were at hand for determining sea level at Atlantic City, these observations being for the month of August, 1919, from which sea level read 7.06 ft. on staff. For the same month at the principal tidal station in New York Harbor sea level on staff read 6.53 ft., which is 0.53 ft. above the primary determination of mean sea level. Hence it is concluded that at Atlantic City sea level for that month was 0.53 ft. above mean sea level which

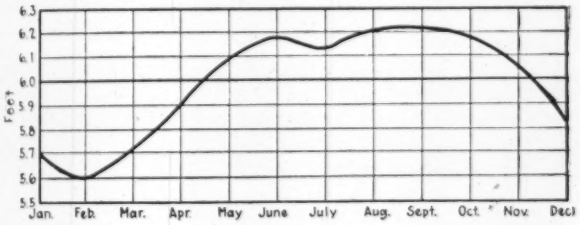


FIG. 1—MONTHLY VARIATION OF SEA LEVEL, N. Y. HARBOR

should therefore read 7.06 — 0.53 = 6.53 ft. on staff. This secondary determination of mean sea level for Atlantic City from one month of observation compares well with the value of 6.58 ft. derived from the nine years of observations.

High Water Planes—For some engineering purposes datum planes defined by high water are required. Various such planes may be derived of which the most important are mean high water, spring high water, higher high water and storm high water. The latter is an arbitrary plane and in no way related to the tides. The first three, however, are tidal datums and are intimately connected with the plane of mean sea level. The plane of mean high water is determined as the average of all the high waters over a considerable period of time. This plane exhibits the same monthly and annual variations as the plane of mean sea level. If the tide curve were perfectly symmetrical with regard to mean sea level the plane of mean high water would lie above the plane of mean sea level by half the range of the tide. Since the tide curve at most places, however, is not symmetrical, the distance between mean sea level and mean high water is not exactly equal to the half range of the tide; in New York Harbor there is a difference of 0.05 ft. This difference once determined permits us to derive the plane of mean high water directly from that of mean sea level and the range of the tide. The range of the tide at Fort Hamilton is 4.7 ft. and the plane of mean high water is found to be 2.3 ft. above the plane of mean sea level.

The plane of spring high water is determined as the average height of the high waters that occur with the so-called spring tides, that is, the tides that come a day after new or full moon when high water rises higher than the average. For any given port there is a definite relation between the planes of mean high water and spring high water. All along the Atlantic coast spring tides rise about 20 per cent higher than the

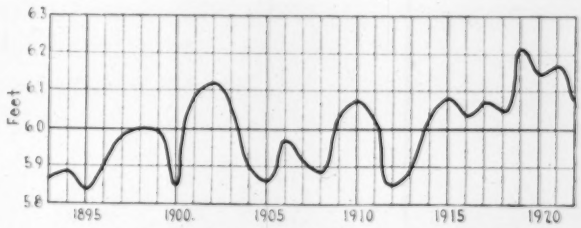


FIG. 2—ANNUAL VARIATION OF SEA LEVEL, N. Y. HARBOR

average; hence the plane of spring high water lies above the plane of mean sea level a distance about 20 per cent greater than that of mean high water.

The plane of higher high water is determined as the average of the higher high waters of each day over a considerable period of time. It is related to the plane of mean high water, lying above that plane a distance equal to half the mean high water inequality. In New York Harbor the plane of higher high water lies 0.3 ft. above that of high water.

It is important to note that the term "high-water plane" is not at all precise, for it does not specify which high water plane is meant. Besides the three tidal high-water planes discussed above, which can be related to the plane of mean sea level through tidal data, there is the storm high water plane that is sometimes used. In fact the term "high water line" so frequently used, generally refers to the line marked by storm high waters. This is not a tidal plane and is not related to mean sea level through the tides. To give the datum of storm high water a precise meaning its elevation above the plane of mean sea level should be determined and recorded whenever used. In New York Harbor the greatest height attained by high water since 1893 occurred on April 11, 1918, when it reached 6.1 ft. above mean sea level. This, it is to be noted, was the height attained by the surface of the water as a whole and not the highest point reached at certain places on shore by the wind-driven waves.

Low Water Planes—In connection with certain engineering work datum planes referring to low water are required, the most important of these being mean low water, spring low water, lower low water and storm low water. They are determined in a manner similar to that described for the corresponding high water planes, and hence no detailed discussion is necessary. It should be emphasized however that the term "low water line" is as ambiguous as the corresponding "high water line." Where an old deed calls for a boundary defined by "low water" or "high water" there is always opportunity for litigation as to the datum plane involved. Had tidal

datum planes been employed no difficulties would arise. Improvement in automatic gages and in the portable gage described in *Engineering News-Record* for Nov. 22, 1923, p. 856, makes it a simple matter for the engineer to obtain short series of tidal observations from which the various tidal planes may be determined.

Subsidence of the Coast—With regard to datum planes there is a fundamental question with which the engineer occasionally has to deal, namely, that relating to an assumed change in sea level due to the supposed gradual subsidence of the coast. Formerly, the evidence presented in support of this view was considered as convincing and a subsidence at the rate of 2 ft. per century for the Atlantic coast of the United States was generally accepted. However, the data on which this conclusion was based were largely of a qualitative character, and recently it has been contended that these data permit of other interpretation. Evidence has been adduced in favor of coastal stability and the belief in the subsidence at the rate of 2 ft. per century has been considerably shaken. This problem is not only one of great interest but one also of very considerable importance, and quantitative data which will permit definite conclusions are much to be desired, but still wanting. Such data are now being obtained by the continuous tidal observations at the fifteen principal tidal stations.

New Formula for Flow of Water in Clean Cast-Iron Pipe

Deduced From All Available Discharge Records by Weighting According to Probable Errors and General Accuracy—Result in Close Agreement with Experiments

By Edward Wegmann
Consulting Engineer, New York City

and

Albert N. Aeryns
Chief Engineer, Thomas F. Bowe, New York City

MANY formulas for the flow of water through clean cast-iron pipes have been proposed by different authorities but none has been generally accepted by engineers. The authors have endeavored to devise a new formula that would agree more closely with the experimental data which are now available than any of the formulas which are in use. The first step in obtaining such a formula was to collect all available records of gagings made of the discharge of clean cast-iron pipes. Data of 260 of such experiments were found, but in plotting the results for a given diameter of pipe, marked differences were discovered, in some cases, between the different gagings.

Weighting the Experiments—Instead of giving an arbitrary weight to each experiment, as has been done heretofore, the authors devised a strictly logical and scientific method of weighting based (1) upon the probable errors in the methods of measurement of quantities used by the experimenter and (2) upon the general accuracy of the experimenter from consistency of results.

The factors that enter into the accuracy of any set of experiments may be grouped under four headings: (1) Measurement of the discharge; (2) measurement of loss of head; (3) measurement of diameter of pipe; (4) general accuracy of the experimenter. The effect of a constant error in any one of the first three factors would not be to make the results of the experiments on any one pipe line inconsistent in themselves, but rather to move the whole curve up or down. Allowances for such constant inaccuracies can readily be made by assigning to each method of measuring its generally accepted percentage of error—thus, measurement of the discharge by means of a standard weir = 2 per cent. The combined effect of these probable errors on the value of C in the Chezy formula was taken as one measure of the accuracy of the experiments.

The effect of an erratic error (sometimes positive, sometimes negative) in the four factors named above would be to make the results of the experiments inconsistent in themselves. The difference in value of C in the Chezy formula given by the individual actual measurements on a pipe line, as compared with that derived from the average curve line drawn through the plotted measurements, was a second measure of accuracy.

The accompanying table gives the relative accuracy of the experiments by these two methods. The weight adopted for each set of experiments was in general the reciprocal of the average for the relative values.

METHOD USED TO GET WEIGHTED AVERAGE OF RELATIVE VALUE OF 260 HYDRAULIC EXPERIMENTS

Experiment Numbers	Diameter of Pipe Inches	Relative Accuracy of Experiments, Per Cent: Based on Probable Errors in Methods of Measurement	Based On Consistency in the Results	Average of the Two Methods	Weight Adopted: Reciprocal of Average Relative Accuracy
1–5	3.	12.5	4.2	8.4	12
6–18	3.22	6.3	2.5	4.4	23
19–23	3.97	5.7	2.5	4.1	24
24–27	4.01	5.7	0.6	3.2	31
28–32	4.02	5.7	53.9	29.8	3
33–37	4.02	5.7	6.2	6.0	17
38–41	4.	11.0	1.6	6.3	16
42–45	4.	11.0	1.1	6.0	17
46–49	5.	9.6	4.1	6.8	15
50–59	5.39	3.8	3.8	3.8	26
60–64	6.00	4.2	3.7	4.0	25
65–66	6.	4.2	10.7	7.5	13
67–78	6.	4.2	20.4	12.3	8
79–81	6.	4.2	0.5	2.3	43
82–85	6.	8.6	1.2	4.9	20
86–94	7.43	2.3	4.1	3.2	31
95–97	8.	8.6	0.5	4.6	22
98–101	7.94	2.7	2.3	2.5	40
102–107	9.94				[1]
108–114	9.95	3.3	1.7	2.5	40
115–117	10.	7.8	3.3	5.6	18
118–120	12.	3.2	1.5	2.3	[2]
121–128	12.01	3.2	16.2	9.7	10
129–138	12.01	2.0	3.0	2.5	40
139–146	12.05	3.2	1.9	2.6	[3]
147–162	12.01	3.2	77.8	40.5	2
163–172	12.	5.9	5.7	5.8	17
173–177	12.00	3.5	1.5	2.5	40
178–182	16.02	3.3	1.5	2.4	42
183–186	16.48	0.7	2.3	1.5	67
187–195	19.68	1.0	6.5	3.7	27
196–203	20.	6.0	2.3	4.1	24
204–207	20.00	2.9	3.6	3.2	31
208–209	21.	5.4	....	....	[4]
210–214	24.	2.7	2.2	4.0	25
215	24.	4.6	....	....	[5] [6]
216	30.				
217	28.	3.5	....	....	[5]
218	32.				
219–223	30.	5.4	1.0	3.2	31
224–236	30.	5.4	10.5	8.0	12
237–239	29.96	3.1	1.5	2.3	43
240–244	30.	5.4	2.0	3.7	27
245	30.	4.8	....	....	[7]
246–248	36.49	0.3	....	....	[8]
249	36.	3.2	....	....	[8]
250–253	48.00	2.1	2.7	2.4	42
254	48.	3.9	....	....	[8]
255–258	48.	3.9	2.7	3.3	30
259–260	61.125	2.1	2.7	2.4	42

[1] Velocities are all below 1 ft. per second.
[2] Weight made = ° because of obstruction in pipe.
[3] Weight made same as for Experiments 65–66 because of possibility of air being in pipe.
[4] Weight was based only on the first method.
[5] As grade is irregular and pipe is compound, weight was made somewhat lower than the first method gives.
[6] Weight was assumed same as for Experiments 215 and 216.
[7] As grade is very irregular weight was assumed somewhat lower than first method gives.
[8] Weight is assumed.

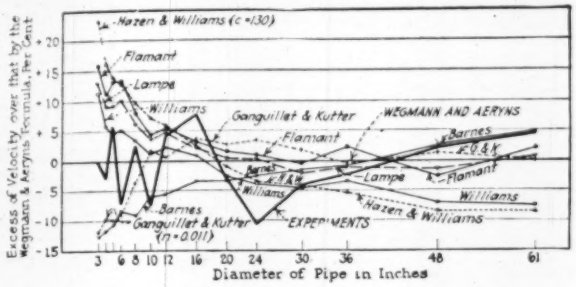


FIG. 1—COMPARISON OF VELOCITY: WEGMANN AND AERYNS FORMULA AND OTHER EXPERIMENTS AND FORMULAS

Derivation of Proposed Formula—The loss of head or pressure in a pipe conveying water is mainly a function of the velocity, the diameter, and the character or smoothness of the inside of the pipe. The relation existing among these variables is expressed by a general equation of the form:

$$S = kV^n D^p \qquad (1)$$

where S = loss of head in a given length, called the slope of the hydraulic gradient;

V = velocity of the flowing water;

D = diameter of the pipe;

k = a coefficient, depending on the character and smoothness of the inside of the pipe, but constant for any degree of roughness;

n and p = constants for a particular class of conduits, such as cast-iron pipes.

The form of this equation is borne out by the results of the experiments, which show that the loss of head increases with an increase in the velocity but decreases with an increase in the diameter. Hence, the exponent n must be a positive quantity and the exponent p a negative one, both greater than unity.

The values of the constants of equation (1) were found by applying the method of logarithmic homologues to the straight line function obtained by changing the exponential form of the equation into the logarithmic form.

As a means to computing the values of these constants, two subsidiary forms of equation (1) were used. One covered the relationship between the slope and the velocity for a given diameter of pipe:

$$S = (kD^p)V^n = mV^n \qquad (2)$$

or $$\log S = \log m + n \log V \qquad (3)$$

The other expressed the relationship of the slope to the diameter for a unit velocity of flow:

$$m = kD^p \qquad (4)$$

or $$\log m = \log k + p \log D \qquad (5)$$

Values of the exponent n were computed for each set of experiments by means of equation (3). They ranged in general from 1.60 to 2.20 and the weighted average value was 1.856. Next, using 1.856 for n, the value of m was computed for each set of experiments; also the logarithms of the upper, middle and lower centers of gravity of the weighted values of m and D. Then, by substituting these logarithms in equation (5), the value of p was found to be —1.342. Finally, the value of the constant k was computed by substituting in equation (5) the logarithm of this value of p and of the middle center of gravity value of m, and found to be 0.0004085.

By substituting the values of n, p and k in equation (1), we obtain a general expression for the relation that holds among the three variables, loss of head, velocity and diameter:

$$S = 0.0004085\, V^{1.856} D^{-1.342} \qquad (6)$$

Transposing this equation and using the hydraulic radius instead of the diameter, we have the new formula for the flow of water through clean cast-iron pipes:

$$V = 182.5\, R^{0.723} S^{0.539} \qquad (7)$$

Comparisons and Conclusions—The best test of any

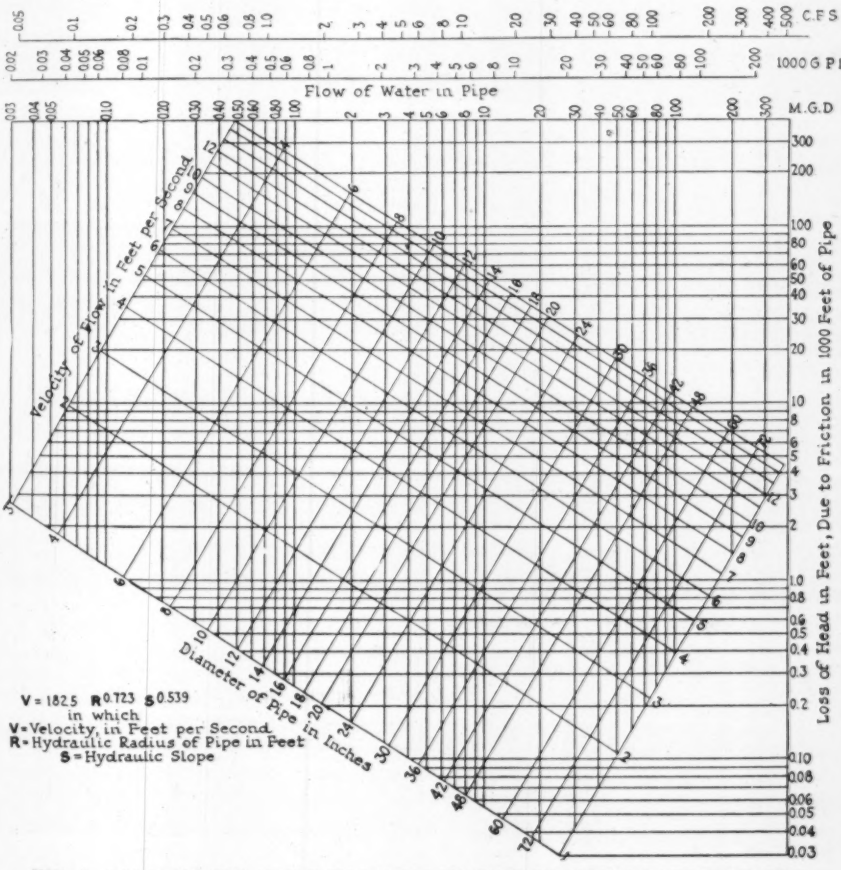

C.F.S
1000 G.P.M.
Flow of Water in Pipe
M.G.D
Velocity of Flow in Feet per Second
Diameter of Pipe in Inches
Loss of Head in Feet, Due to Friction in 1000 Feet of Pipe
V = 182.5 R^0.723 S^0.539
in which
V = Velocity, in Feet per Second.
R = Hydraulic Radius of Pipe in Feet
S = Hydraulic Slope

FIG. 2—DIAGRAM FOR FLOW OF WATER IN NEW OR CLEAN CAST-IRON PIPE BASED ON WEGMANN AND AERYNS' FORMULA

A new formula based on 260 records of experiments. In comparing the experiments a double weighting was used based on (1) probable errors in methods of measurement of quantities used by the experimenter and (2) general accuracy of the experimenter as evidenced by consistency of his results.

formula is its agreement with the actual facts recorded by experiment. The new formula for the flow of water in clean cast-iron pipes has, therefore, been compared with the experiments and also with the formulas proposed by Hazen and Williams, Williams, Ganguillet and Kutter, Barnes, Flamant and Lampe (Fig. 1).

For all the experiments the weighted average per cent of variation in velocity from that by the new formula is as follows: Experiments —0.5; Hazen and Williams, +5.6; Williams, +1.1; Ganguillet and Kutter, +1.1; Barnes, —5.6; Lampe, +4.2; Flamant, +5.9.

An examination of these average per cents and Fig. 1 reveals the following:

(a) The plus and minus variations of the experiments from the Wegmann and Aeryns formulas are comparatively small, and are well distributed among the different sizes of pipe. The average per cent of variation is less than with any other formula. If the known erratic results of some of the experiments are taken into consideration, these variations indicate that the formula agrees very well with the experiments.

(b) With the Hazen and Williams formula ($C = 130$) the plus variations occur mainly with the small pipes and the minus variations with large pipes. The average per cent of variation is next to the highest. The velocities by this formula would be too high for small pipes and too low for large pipes.

(c) The Williams formula gives variations somewhat more evenly distributed among the different sizes of pipes than those of the Hazen and Williams formula; nevertheless, the plus variations are principally with the small pipes and the minus with large pipes.

(d) For large pipes, the Ganguillet and Kutter formula ($n = 0.011$) gives velocities which are in good general agreement with the Wegmann and Aeryns formula—in other words, with the weighted average of the experiments. However, the velocities for small pipes (3 to 8-in.) are consistently low; this is not surprising as this formula is applicable to channels and large conduits rather than pipes.

(e) The variations by the Barnes formula are similar to those by the Ganguillet and Kutter formula but to a greater extent. The average variation (5.6 per cent) is comparatively high.

(f) The velocities by Flamant's formula agree fairly well with the experiments on 16-in. and larger pipes, but on the smaller sizes the velocities are all high. The average variation by this formula is larger than by any of the others considered.

(g) The results by the Lampe formula are similar to those by the Flamant formula.

Summing up this comparison, the Wegmann and Aeryns formula agrees with the experiments better than any of the others. The average deviation is less and the variations are evidently due to the inconsistency in the results of the experiments.

Material Excavated from Panama Canal Prism

A recent issue of the *Panama Canal Record*, in commenting on what has been accomplished since the Panama Canal was opened 21 years ago, stated that in excavating the canal and in maintaining the channels, harbors, etc., the total excavation by American forces from the canal prism, harbors, channels, etc., up to May 3, 1925, totaled 325,287,600 cu.yd. If to this is added 29,908,000 cu.yd. excavated by the French, the total to May, 1925, was 355,195,600 cu.yd.

Rapid Concreting of Apartment Building at Chicago

Twelve Floors in One Month—Compression and Slump Tests—Construction Plant —Features of Structural Design

NOVELTY in design and rapidity of construction, with frequent tests to insure good concrete, are interesting points in a 19-story reinforced-concrete apartment building erected in 1924 at 20 Cedar St., Chicago. The special design feature is that each apartment includes two floors but has the living rooms two stories high, as shown by the accompanying views. Living, dining and service rooms are on the lower floor, with bedrooms on the upper floor and flanking the two-story rooms. The building is T-shaped in plan, 120 ft. deep, with the two ends 60 and 136 ft. wide and with the narrower stem thirteen and sixteen stories high, while the wider portion has nineteen stories. It is intended for co-operative ownership by the occupants and provides apartments having from six to fourteen rooms. Its total floor area is 195,000 sq.ft.

Reinforced concrete is used throughout, with a framing plan made irregular in order to fit the layout of the architectural design, so that the column spacing varies from 16 to 22 ft. To secure a minimum of obstruction the columns are arranged mainly at the junctions of partitions; the largest columns are 24x40 in. and 16x64 in., each with about 40 sq.in. of steel bars. In the living rooms, where the largest spans occur, the beams are longitudinal, with transverse joists between them; spandrel beams over the wide window openings of these rooms are reinforced with steel channels. In typical floors the joints are 10 in. deep with a 2½-in. slab, or a total depth of 12½ in. All floors are designed for 40-lb. live-load. The roof framing is similar to that of the floors except that under the penthouse there is a 3-in. slab with 12-in. joists on account of the heavier loading. This penthouse, of reinforced-concrete framing with brick walls, contains the elevator machinery, ventilating fans and a 10,000-gal. service tank. The story height is 10 ft. 3 in., increased to 13 ft. 3 in. for the twelfth and nineteenth stories and 18 ft. for the basement.

A 36-in. foundation slab covering the entire area is designed for a soil bearing of 3,500 lb. per square foot. Reinforced-concrete curtain walls built monolithically with the first floor spandrels and extending down to this slab enclose the basement, which contains the heating, refrigerating and water treatment plants, 60-ton coal bunker and service storage space. The steel smokestack is outside the building. For passenger service there are two 2,000-lb. electric elevators running

DATES OF COMPLETING FLOOR SLABS, 1924

Foundation	May 5	Floor 10	June 17
Floor 1	May 15	11	June 18
2	May 23	12	June 21
3	May 27	13	June 23
4	May 31	14	June 26
5	June 3	15	June 28
6	June 6	16	July 1
7	June 9	17	July 3
8	June 12	18	July 8
9	June 13	19	July 20

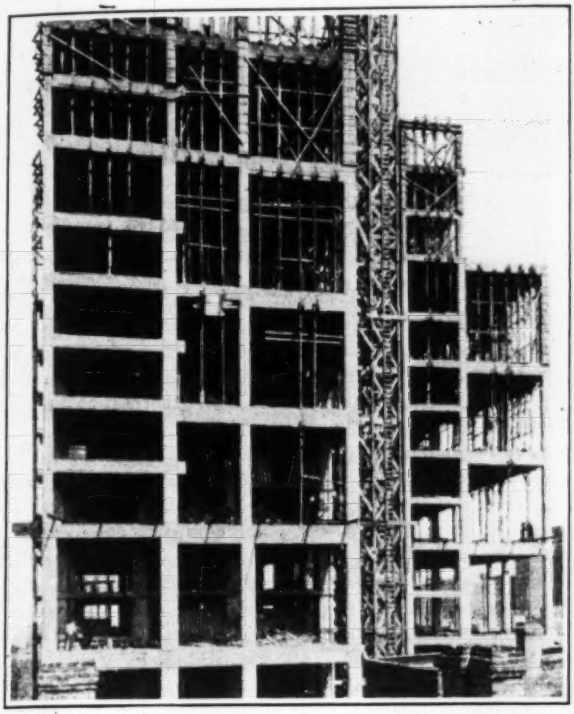


FIG. 1—CONCRETE FRAME OF CHICAGO APARTMENT. Note two-story height of living rooms.

at 400 ft. per minute and handled by operators, but push-button control is used for the 2,000-lb. freight elevators, which run at 150 ft. per minute.

In the floor slab are embedded the electric conduits and plumbing pipes, as well as hangers for carrying other piping between the joists. Ceilings of plaster or expanded metal are attached to furring strips under the joists except in the two lofty stories, where they are suspended 3 ft. below the joists, and in the living rooms, which have vaulted ceilings. Red brick and white terra cotta of dull finish are used for the exterior.

Construction Progress and Plant—Excavation was started on March 14, 1924, and the concreting of the foundation on May 1. From the accompanying table of progress it will be seen that the twelve stories above the fifth floor were placed in a month, or at an average of about three floors (10,000 sq.ft. each) per week. After the eighteenth floor had been completed there was a delay of two weeks.

Wood forms for the joists were built on the work and were reused three to five times on an average. The type of shore used had a 4x4-in. stick for the top section, sliding in a cast-iron collar on a lower section composed of four angles fitted with supports at 6-in. intervals to hold a short cross-bar of I-beam section. Accurate setting or adjustment was effected by means of a jackscrew in the base. This construction facilitated the setting up and removal of floor forms. With the practically uniform story height, sectional wood column forms, which were reused four or five times, simplified the form erection problem. Weather conditions were favorable, although rain interfered with the finishing of the floor slabs.

The main construction plant consisted of a ¾-yd. concrete mixer with electric motor, a 1-yd. concrete skip elevator, two platform elevators for brick, tile and other work, and two self-dumping skip elevators for steel rods, form lumber and woodwork. All the elevators were operated from two triple-drum steam hoists. Other equipment included pumps, several small gasoline-operated concrete mixers and a wood-working outfit in the carpenter shop. An adjacent two-story building housed the construction office, timekeeper's office, repair shop and tool storage. The main concreting was done with the large mixer, located in an angle of the building, together with the towers for concrete skip elevator and material cage elevator. Concrete aggregates were dumped in storage piles and delivered by wheelbarrows to the mixer, where the cement was added. To facilitate charging, the mixer was placed below street level and the skip dropped below the mixer. At the top of the tower, the skip dumped the concrete into a 1½-yd. hopper, the flow from which to the chutes was regulated by a man on the hopper platform, who also signaled to the mixer crew. Two 50-ft. lengths of chutes were suspended from cables leading from the top of the tower to the corners of the building.

To insure a good quality of concrete and avoid any chance of defective material due to rapid progress, frequent slump tests were made by the architect's superintendent, while a testing company took samples of the concrete from each tier of columns and each floor slab. Compression tests on cubes made from these samples are said to have shown a higher strength than that required by the Chicago building code for the mixtures used, which were 1:1:2 for columns and 1:2:3½ for slabs. The cost of this inspection and testing is said to have been considerably less than 1 per cent of the cost of the cement used.

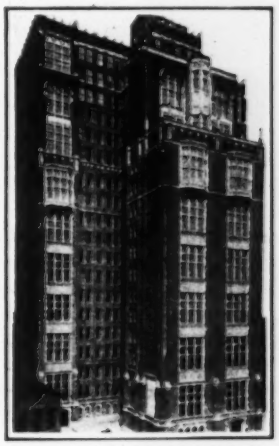


FIG. 2—DUPLEX-STORY APARTMENT BUILDING The large windows are for two-story rooms.

This apartment building was designed by Fugard & Knapp, architects, Chicago, with Samuel Klein as structural engineer. The general contract was let to the McLennan Construction Co., which did all the concreting and sublet the masonry, carpentry and other work. All structural work was done under the terms of the Landis Award and open-shop conditions existed for the greater part of the construction. With a total cost of about $1,250,000 the unit cost is given as 62½c. per cubic foot, or $6.40 per square foot of floor area.

Hydro-electric Survey in Ontario

The Ontario Director of Surveys working in conjunction with the Dominion Water Power and Reclamation Services, the Department of Mines, and the Provincial Hydro-electric Power Commission, has issued a report upon the hydro-electric resources of Ontario which shows a material increase over former estimates. The available horsepower at Niagara Falls according to this report is 6,720,000 hp. without using the total potential power of the Niagara River. If this is included the figure given is 9,000,000 hp.

Salt Lake Meeting of American Society of Civil Engineers

Irrigation and Land Settlement Problems Dominate Discussion— Five Technical Divisions Meet Simultaneously

"A SUITABLE place and an opportune time" aptly characterizes the Salt Lake meeting of the American Society of Civil Engineers last week. Irrigation problems received major attention. Not only were full morning and afternoon meetings of the general session devoted solely to this subject but thirteen additional papers on the same general subject were read before the irrigation division. Although the attendance was not large (about 220 members and guests), the speakers included many national authorities on irrigation.

In addition to excursions of scenic interest and a swim in the buoyant waters of the lake (salt content 21 per cent), delegates enjoyed an organ recital on the world-famous organ in the Mormon tabernacle and afterward inspected the remarkable wooden roof trusses of this structure, which have a span of 150 ft. and are held together with dowels and rawhide thongs.

George H. Dern, governor of Utah, who made the address of welcome at the opening session, is an engineer by training. His address was most favorably received, particularly his emphasis on the desirability of selecting engineers for positions of authority in state government.

Reclamation Past and Future

Record of the Service—A. P. Davis, formerly chief engineer of the United States Reclamation Service, spoke in defense of federal reclamation work, pointing out that of the total federal investment of $190,000,000 in irrigation projects one-third has been made from repayments by settlers, which is believed to be the largest proportion of returns shown by any national construction except the Panama Canal. The twenty-five federal irrigation projects, he said, produce annually from $50,000,000 to $90,000,000 worth of crops, the products thus equaling the total investment every three years. The estimated increase in land values due to this development has been $650,000,000, or more than three times the investment.

Federal Corporation Proposed—A suggested solution of some of the problems which face irrigation development was made by R. E. Shepherd, manager, North Side Twin Falls Land and Water Co., Jerome, Idaho, in the form of a corporation created by Congress. The corporation would be a business enterprise, fostered by the government somewhat as are the Federal Reserve Banks and the Federal Land Banks. It would take over operation of existing projects, issue bonds for needed new construction and in general its business would be the reclamation of waste lands of the country. Thus reclamation would be taken out of politics, would have the advantage of private enterprise and would be independent of changing administrations.

Irrigation Overdeveloped—John E. Field, consulting engineer, Denver, while approving the Shepherd suggestion, stated that there is now a surplus of land under irrigation ditches and a surplus of nearly every agricultural product, which, coupled with the fact that settling irrigation projects is not now generally attractive, leads to the conclusion that federal activity in reclamation matters should be confined to completing projects now under way.

Making High-Cost Irrigation Feasible

Need of Farmer Financing—A paper by Dr. Elwood Mead, Commissioner of Reclamation, stressed the necessity for revision in federal reclamation policy to meet new social and economic influences. Higher costs and agricultural depression require that settlement and farm development be given important places in the reclamation program. On five reclamation projects authorized by the last Congress on which work has not yet begun, and on two just completed, the construction costs average $125 per acre; by the time the water right and farm development cost is added to the land cost, and before the first crop is produced, the settler will face a cost of $200 to $250 per acre or from $4,000 to $10,000 per farm.

Either extension of federal irrigation work should cease or aid and direction in settlement and in farm development work should be made a part of the government's program. If the latter course is chosen the farms must be small and intensively cultivated and settlers must be selected, must have thrift and industry and must be helped with their financing. On this last point Dr. Mead stated that settlers cannot be secured with sufficient capital of their own. Seventy per cent of the applicants to the Reclamation Bureau have less than $1,500 and only ten per cent have over $2,500. The additional capital must be provided on better terms than can be expected from banks or private interests. Where the government undertakes these aids the project requires a superintendent who will see that advances are made only for definite and necessary improvements.

Commenting on Dr. Mead's paper, B. A. Etcheverry, professor of irrigation engineering at the University of California, pointed out that the 1924 report of the commissioner of reclamation states that on many federal and private projects of the Northwest well improved farms now in production can be bought for $150 per acre including paid-up water rights. In view of this situation the postponement of new developments that would cost as high as $250 per acre was suggested. A further suggestion of desirable reclamation policy was that the federal government might take low-interest bonds of new districts for ten years, say, and then sell them when the project is established. If results were below expectations the government could absorb some or all of the loss if so desired by canceling some of the bonds and selling only enough to represent a fair value of the project.

Influence of Modern Conditions—Further comment on Dr. Mead's paper from T. H. Means, consulting engineer, San Francisco, brought out the fact that the settlers of today regard as necessities many costly things that were not formerly needed. Men with the cash necessary for farm development are unwilling to undertake the hard labor involved. Comparatively few

settlers are nowadays interested in land development unless there is opportunity to ultimately make a profit in the sale of the land. Either the cost of reclamation must be reduced or the settler must be subsidized in some way. If the reclamation of the west is to be completed a logical next step would be the appropriation by Congress of reclamation funds in excess of expected return. Private enterprise cannot be expected to do the more difficult reclamation work.

Government operation of irrigation works should cease, Mr. Means believes, because of the inevitable striving of the water users for escaping government payments. Politicians always work on this possibility and the effect on the communities is bad. Long-distance management (from Denver or Washington) is unsatisfactory; local management and assumption of responsibility by water users should be substituted.

Success of Districts—J. B. Lippincott, consulting engineer, Los Angeles, pointed out that land in California irrigated under the state irrigation district law totals more than twice the aggregate area of federal reclamation projects and of all this area only three per cent is in any way delinquent in payments. The land and the settlers are much the same as on federal projects, the contrast in delinquencies between California districts and federal projects generally is in the *necessity* for the settler to pay under the district plan while federal obligations are so often remitted under political pressure.

For each paper at this convention a secondary paper on the same subject had been prepared, classified as "discussion." In most cases, however, the discussor had not seen the paper when his discussion was prepared and the result was that while many different points of view were presented there was little critical comment or true discussion. The time in the general sessions and the irrigation division, at least, was barely sufficient for the papers already prepared, so that practically no general discussion was possible.

The morning was devoted to the simultaneous sessions of five of the technical divisions—irrigation, power, highway, structural and city planning. Necessarily the attendance in each was small.

Technical Irrigation Subjects

The irrigation division meeting on Thursday morning was devoted chiefly to technical subjects. S. T. Harding, associate professor of irrigation, University of California, read a report on the findings of the committee appointed to investigate the duty of water; O. W. Israelson, professor of irrigation and drainage, Utah Agricultural College, Logan, reported the results of an exhaustive study of the consumptive use of irrigation water. He used mathematical formulas as an aid in analysis and in stating findings. The present status of co-operation between federal and state agencies in irrigation investigations was reviewed by Fred C. Scobey, senior irrigation engineer, United States Department of Agriculture, Berkeley, Calif., who also gave some time to "the future in irrigation investigations."

The irrigation division closed its session with two rather contrasting views on interstate water problems and their solution, by speakers from Colorado and Wyoming — two states that have long fought legal battles on this question.

An exhaustive paper prepared jointly by M. C. Hinderlider, state engineer, Colorado, and R. I. Meeker, engineer on interstate river problems, Colorado, presented the side of the question favoring the compact plan. In addition to showing the advantages of this method the paper reviewed the history of the compact idea and presented much data on recent interstate decisions and recent interstate legislation generally.

In the other paper Frank C. Emerson, state engineer, Wyoming, disagreed with the Colorado representatives in their feeling that the compact plan is the best solution. Rather, he urged, interstate water rights should be settled by conference, and engineers should aid by taking more interest in those problems which, though of great engineering importance, are first of all political in nature. He urged that every effort be made to avoid methods of settling interstate questions that may call for litigation or adjudication. After eleven years of costly litigation the decision of the United States Supreme Court on the Colorado-Wyoming water case did not bring material gain to either state, he said, while on the other hand representatives of the two states could have reached an agreement in conference within two years that would have been reasonably satisfactory to both states.

Irrigation vs. Power

In the power division the principal paper, which dealt with the relation of stream regulation to irrigation and power development, was presented by J. C. Stevens, consulting engineer, Portland, Ore. In this paper and the discussions that followed it was held that in the arid west irrigation should have a first claim to the water supply in preference to power. Power will benefit in the long run by conceding such preferential use. Water is indispensable for irrigation but not for power. Complete regulation of the water supply of the arid west for irrigation will require the storage of 40 per cent of the annual low-water yield. Were the water supply so regulated, power use could then be made of about 60 per cent of that supply without interfering with irrigation.

Other Proceedings

The structural division devoted its time to a discussion of the working stresses in steel recommended by the society's special committee on the subject and of those recommended by the American Institute of Steel Construction. Consideration was given also to the report of the joint committee on specifications for concrete and reinforced concrete, resulting in a resolution that the officers of the division be requested to arrange in co-operation with the society's committee on technical activities and publications for a discussion of that report at a future meeting of the division.

The highway division devoted its session to (1) a paper on the finishing and curing of concrete roads and (2) a general interchange of ideas on snow removal problems on state highways. On this latter subject papers were read by the state highway departments of Utah, Wyoming and Colorado and by the United States Bureau of Public Roads.

The city planning division held discussions on the development of industrial sites and trackage layouts, following a paper by Walter R. Armstrong, general superintendent, Los Angeles & Salt Lake R.R., on that subject.

Well-Drilling Methods Applied to Sinking Foundation Piers

Large Cylinders Put Down With Churn Drill in Soft Ground—Method Tried in Rutherford, N. J.

BY ADAPTING well-drilling methods to sizes several times as large as anything heretofore customary, N. R. Osborne, of the Osborne Drilling Co., New York, recently succeeded in applying the method to sinking foundation piers through soft ground where otherwise pneumatic caisson work would be required, and to depths beyond the range of pneumatic work. Where the ground is suitable piers can be put down rapidly and cheaply. Where boulders are present in the ground, however, the method cannot be applied, as boulders deflect the cutting bit and the casing.

Deep reinforced-concrete foundations were put down for the New Jersey ventilating shaft of the Hudson River vehicular tunnel by well-drilling methods two years ago, as described in detail with illustrations of tools and equipment in *Engineering News-Record* of Feb. 8, 1923, p. 242, "Driving 250-Ft. Piles for Hudson River Tunnel Shaft." In this case the pipes were 24 in. in diameter, and they were put down to rock, about 250 ft. below water level, and after concreting were cut off 106 ft. below water, to form a foundation on which the shaft caissons subsequently were landed. In using the method for larger cylinders, some changes in tools, casing and methods from those used in the work just referred to are found necessary.

The spud or bit used is shorter, and therefore relatively lighter, than the bits used in drilling to sizes of 24 in. and less. For cylinders from 42 to 50 in. in diameter the bit is about 1 in. smaller than the inside diameter of the pipe, or just enough to clear the inside couplings of the pipe, and is about 5 ft. high and 16 to 18 in. thick, weighing 5 to 8 tons. The cutting edge is horizontal lengthwise, and forms a very flat V in vertical cross-section. The outline and method of suspending the bit are important. The bit is unsymmetrical in side elevation, the stem being a few inches to one side of the center and the outline of the larger side being gently curved from top to cutting edge. By virtue of the off-center suspension the bit, working a few inches below the bottom of the casing, undercuts the casing, thus producing a hole several inches larger than the diameter of the bit and enabling the casing to follow it down freely. To facilitate the penetration of the casing the couplings are inside the pipe. Where conditions do not require special types of couplings, simple collared sleeve couplings are used to avoid the difficulties attendant upon threaded connections.

In sinking cylinders of 44- and 46-in. diameter by this method, it has been found that through the action of the undercutting bit the casing follows down automatically, keeping within 3 or 4 in. of the bottom of the excavation. The drilling was done in water, and the excavated material was removed by mud pumps, similar to those used in regular oil-well work but larger.

Rutherford Job—Foundation piers carried to rock had been designed by the architects of the new Rutherford (N. J.) exchange of the New York Telephone Co. The soil at the site was mixed ground, and as the water table was relatively high, pneumatic caisson work was contemplated. At the suggestion of the Foundation Co., contractor for the work, approval was given to using the drilling method for sinking the piers.

Accordingly equipment was installed, including a No. 30 Star well-drilling machine, to sink 46-in. cylinders an anticipated depth of 60 ft. to bedrock. The subsoil was glacial drift including clay and gravel strata containing many boulders of various sizes, overlying quicksand. Sinking went on according to expectations until the edge of the shell of the cylinder struck the side of a boulder. At this point the cutting bit was deflected by the boulder, and the casing tended to follow in the deflected direction, throwing the cylinder out of plumb. Long-continued efforts were made to pass the obstructions without disturbing the alignment of the casing, but all failed, and the method was finally abandoned. Spread footings in the upper strata were substituted for the deep piers.

Similar pier sinking in marsh soil containing no boulders proved entirely successful. Rates of sinking up to 8 ft. per 8-hr. shift were readily obtained, and the difficulties did not increase with depth.

Advantages inherent in the method are rapid sinking, simple and compact plant involved, independence of depth of foundation from limit of pneumatic work, and ability to unwater the shaft before filling, so that the concrete can be placed in the dry and such reinforcement can be included as may be desired.

Civil Engineers' Board Opposes Advertising for Engineers

THE following resolution was adopted by the Board of Direction of the American Society of Civil Engineers at its meeting in Salt Lake, July 6:

WHEREAS, the Board of Direction of the American Society of Civil Engineers has had brought to its attention the fact that on occasions public authorities ask engineers through advertisements to submit in competition their terms for preparing plans for engineering projects, frequently requesting that such tenders be accompanied by an estimate of the cost of the proposed project, and

WHEREAS, such procedure is not in the public interest, it being contrary to recognized practice in engaging professional services, thereby asking of engineers a form of competition inconsistent with professional ethics, and consequently tending to eliminate the services of qualified engineers of high professional character,

THEREFORE, BE IT RESOLVED: That the Board of Direction of the American Society of Civil Engineers emphatically records its disapproval of such procedure, and recommends that public authorities and others desiring to secure professional engineering services, select an engineer, from those available, on the basis of his qualifications, experience and professional reputation for work of the size and character under consideration, determining by inquiry of recognized professional authority the appropriate basis of compensation for such services.

Part of Alaska to Be Surveyed by Airplane

The Department of the Interior, through co-operation of the Navy, expects to map the southeastern portion of Alaska by airplane photography. It is expected that sea planes will be used for the flying due to the lack of proper landing places on the mainland of Alaska. Although the proposed maps are to be made primarily in connection with the investigation of the mineral resources of Alaska by the Geological Survey, other bureaus such as the Coast and Geodetic Survey, the Forest Service, the General Land Office, and the Federal Power Commission expect to benefit by the survey and will assist as far as possible in the work.

New Cantilever Bridge Designed With Architects' Co-operation

New Point Bridge in Pittsburgh Planned to Satisfy Requirements Laid Down by City Art Commission

By Norman F. Brown
Director, Department of Public Works, Allegheny County, Pittsburgh, Pa.

BIDS for construction of the piers of the new Point Bridge over the Monongahela River at its junction with the Ohio, in Pittsburgh, were received by the commissioners of Allegheny County, Pa., on June 3. The new bridge, the general appearance of which is shown by the adjoining perspective, is located close to the existing Point Bridge, which will remain undisturbed until the new structure is opened to traffic. Detail designs of the superstructure are being worked out in the county's Department of Public Works by the Bureau of Bridges, through V. R. Covell, county engineer, T. J. Wilkerson, consulting engineer, and A. D. Nutter, engineer of bridge design.

NEW POINT BRIDGE OVER ALLEGHENY RIVER AT PITTSBURGH
Photograph from crayon perspective. Main span, 670 ft., anchor spans, 225 ft.; center depth from deck to top chord, 125 ft. Contracts for pier construction are about to be signed.

The City Art Commission has played a decisive role in determining the outline of the structure and artistic features to be adopted. By a legislative act approved May 11, 1921, all public structures erected within Pittsburgh must be approved by an Art Commission, which is composed of the Mayor and the Director of Department of Public Works as ex-officio members; one painter, one sculptor, three architects; and two others, neither of whom shall be a painter, sculptor or architect.

In determining the type of the new Point Bridge, the Art Commission was influenced to a large extent by the appearance of the existing Manchester Bridge, which spans the Allegheny in the same location, the approaches of the two bridges actually merging together on Pittsburgh's Point. Looking up the Ohio River, the two structures are inseparably linked together as companion bridges. Accordingly, the Art Commission imposed the following three conditions:

(1) The silhouette should be convex.

(2) The structure should be an entity from end to end.

(3) There should be a clear view from the roadway.

The first condition eliminated the suspension and usual cantilever forms, because of their concave silhouette. The second condition enforced a continuous truss or modified cantilever form. The third requirement practically eliminated all truss forms having the intersections of the web members near the roadway level. Governed by these restrictions, the consulting and designing bridge engineers prepared the attached illustration, which was selected and approved by the Art Commission from some 22 exhibits.

The approved design has a cantilever form with arched lower chord outlines in both anchor and cantilever arms, and with a rather flat convex upper chord extending from anchorage to anchorage. The main channel span will be 670 ft. long from center to center of piers, and each anchor arm 225 ft., making a length of 1,120 ft. from anchorage to anchorage and 1,330 ft. including approaches. The maximum rise of the lower chord above the roadway will be 90 ft., the depth of the suspended span will be 35 ft., and the depth of the trusses over the piers 114 ft. The trusses will be 44 ft. apart, center to center. The clearance height under the bridge will be 70 ft., which was the clearance specified by the War Department. The roadway floor is suspended from the lower chord, the hangers presenting the only obstruction to vision. The engineers have designed this bridge for two lines of street cars and two lines of vehicles. It has a roadway width of 38 ft. in the clear, and two 12 ft. sidewalks.

The floor system of the bridge was proportioned for a live-load equivalent to three 18-ton trucks for each line of vehicle traffic and for two 60-ton trolley cars for each track, together with a sidewalk live-load of 100 lb. per sq.ft. The trusses were proportioned for a varying live-load and impact load, depending upon the loaded length of span, with a maximum of 6,700 lb. per lin.ft.

Considerable study has been given to provision for suitable and safe traffic conditions at the approaches of the new bridge. At the south end, Carson St. (running along the river transversely to the bridge) is an important through artery of traffic. Plans are being developed which will permit the through traffic on Carson St. to pass under the bridge approach, so that it will not be delayed by or conflict with the traffic crossing the bridge. At the Pittsburgh end, the approach is being studied so that the traffic entering and leaving the two bridges (the new Point Bridge and the existing Manchester Bridge) will be congested the least possible amount.

The amount approved in the people's bond-issue vote of April 22, 1924, for this structure is $2,350,000.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Reinforced-Concrete Study in Russian

COMMENTS BY WILLIAM K. HATT
Professor of Civil Engineering, Purdue University, Lafayette, Ind.

A study of "Stresses and Deformations in Reinforced-Concrete Structures Due to Changes of Volume of Concrete," by W. O. Freyberg, Petrograd Graduate Communications Engineer, fills some 50 pp. of the *Journal* of the Russian-Chinese Polytechnic Institute for 1923 (published at Harbin, China). The study is written in Russian but is followed by a short abstract in English on which the following comments are based.

Mr. Freyberg presents formulas and coefficients for calculating the stresses in various reinforced-concrete structural elements due to expansion and contraction arising from changes in moisture and temperature. The calculations for shrinkage, he says, should be made at the age of two years, when $n = 8.4$ and E of concrete = 3,700,000 lb. per sq.in. The shrinkage of plain concrete is equivalent to a change of temperature of +37 deg. C. He believes that the methods are wrong, as recommended in the Swiss and other European building laws, which specify that stresses should be computed upon a basis of a change of temperature of 20 deg. C. only. The admissible limits of stress are to be increased when such computations are made.

The pamphlet is an indication of the growing interest in the volume changes in concrete structures. The colloidal nature of concrete is generally recognized. Laboratory determinations of shrinkage and expansion are accumulating. However the translation of these into factors of design is uncertain. If we would accept the implications of some writers, it would be hard to believe the evidence of our eyes which see so many structures that have braved the elements for two score years.

Second Issue of Engineers' Who's Who

WHO'S WHO IN ENGINEERING: A biographical dictionary of Contemporaries, 1925—By John William Leonard. Second Edition [Issue]. New York: Who's Who Publications, Inc. Cloth; 6x9 in.; pp. XXI + 2483, $10.

From Aabye to Zworykin, some 18,000 to 19,000 "individuals with claim to representation in a volume dealing with the engineering profession" are included in this book. All parts of the world are represented although naturally the bulk of the names (apparently over 90 per cent) are those of residents of the United States and its possessions. The publishers state in the Preface that in the future they "will attempt to give even more space to the engineering fraternity on other continents." The basis of choice of the foreign representation is not stated.

There are about 8,000 more names in the present issue than in the first one (dated 1922-23).

So far as we can judge the publishers are warranted in stating that "where names sought are not found the explanation of the omission is probably that the requested data were not supplied by the individuals" in question. Omissions of this sort seem to be relatively few in this issue compared with the first one—a fact that indicates an increasing appreciation of a volume which now seems to be established on a sound basis and to warrant the whole-hearted support of engineers and of those who wish reliable information regarding them and their careers.

Pioneer in an Important Field

STREET TRAFFIC CONTROL—By Miller McClintock, Ph.D., Assistant Professor of Municipal Government, University of California, Southern Branch, and Consultant to the Los Angeles Traffic Commission. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 233; 25 halftones and line cuts. $3.

Commendation is due the author for having pioneered so ably in bringing out the first book in a field of rapidly growing importance. Engineers will be pleased to note that the author puts the engineering aspects of his subject foremost and treats them in an engineering way; that is, he first analyzes his problem, then considers ways and means of solving it, first by better street planning to avoid or lessen congestion, then by means of traffic control. The prominence given to comprehensive street planning in a book certain to have wide circulation is encouraging.

After brief consideration of the street traffic problems, there is a chapter on the traffic survey, a prime factor in any intelligent handling of this question. Causes of congestion are taken up, first in the chapter on the street plan, and then in the one on the character of traffic and its regulation. Next comes a chapter entitled Replanning the Street Systems for Traffic Relief. A companion chapter is on Minor and Local Changes to Increase Street Capacity.

Regulation or traffic control occupies the remainder and larger part of the space. There are chapters successively on Moving Traffic, both in general and on Conflicting Routes; Standing Vehicles; Pedestrians and Drivers. Then the Traffic Code, the Traffic Bureau, and Police Equipment and Auxiliary Devices for Traffic Regulation are taken up. The final chapter is on the treatment of offenders.

The book is well done, with a sufficiency of data without having it become burdensome, a few well chosen line cuts, and with able, critical comment on the data presented. The book seems bound to make an important place for itself in engineeering and municipal literature both.

Second Sedgwick Memorial Lecture

PUBLIC HEALTH IN THEORY AND PRACTICE: An Historical Review—By William Henry Welch, M.D., LL.D., Director of the School of Hygiene and Public Health, Johns Hopkins University. New Haven, Conn.: Yale University Press; London: Humphrey Milford, Oxford University Press. Cloth; 5 x 8 in.; pp. 51. $1.

As his keynote, Dr. Welch takes the opening sentence in Professor Sedgwick's first lecture to students of engineering and bacteriology: "The sanitarian needs a proper working theory." The lecture is devoted in part to glimpses of changing theories and in part to working methods in the public health field. There is an inter-

esting reference to the "important Hippocratic book, the first on sanitation, On Airs, Waters and Places," with its stress on the doctrine of miasm, which continued to be held through all the centuries from Hippocrates almost to the present time. Throughout the lecture shows the knowledge, the wisdom and the spirit to be expected from Dr. Welch.

Of Broad Appeal

THE PUBLIC AND ITS UTILITIES—By William G. Raymond, C.E., LL.D., Eng.D., Professor of Engineering and Dean of College of Applied Science in the State University of Iowa. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 346; appendix of operating expense tables, and amortization tables. $3.50.

Dr. Raymond's new book has a broader range of subject matter and appeals to more classes of possible readers than its predecessors in the same general field. Most of the earlier books on utilities have been confined to valuation and rates and have been written more particularly for the professional and official classes or those who might wish to approach the subject from these points of view. The book before us, as its title implies, takes in both the public and its utilities, and this as regards subject matter and possible readers. While non-technical in the sense of avoiding or explaining technical terms in engineering and economics, it is in no sense an elementary treatise and will not repel even the specialist in public utility problems. The wideawake specialist will be interested in the way the subject is presented and in Dr. Raymond's opinions, based on observation, study and practical experience. For the benefit of any educators not aware of the fact, it may be stated that the book is in large part the outgrowth of classroom instruction and may be commended for use in courses in economics, engineering and municipal government.

After a short Introduction and a chapter on The Creation and Earnings of the Utilities, there comes a five-part chapter on Operating Expenses—for water, gas, electric light and power, heating and refrigeration and miscellaneous utilities. Depreciation also occupies five chapters, after which there is a chapter on Emergency Fund, Interest and Sinking Fund, and one on the important subject of Taxes. Next there is a general chapter on rate systems and another on forms of rates; then separate chapters on various kinds of utilities—gas, water, etc.

There are four chapters on utility companies, franchises, public control of privately owned utilities and rate control. This brings the author to value and valuations, on which there is a general chapter, and chapters on Going Value, Depreciation of Valuation and Appreciation, and Fair Return. The concluding chapter is on Engineer's Methods of Inventorying and Valuing Public Utility Property. An appendix contains tabulations of water service costs at Detroit and Holland, Mich. Finally, there are 24 pp. of Amortization Tables, all given by courtesy of the American Society of Civil Engineers except an 8 per cent table computed for this book because "the author thinks that depreciation and depreciation allowances should be computed with an interest rate equivalent to the rate paid on investment in consumable property when the public owns, and to the fair return rate when the property is held in private ownership."

One of many commendable features of the book—commendable for one reason because they are thought-stirring—is that the author treats utilities broadly, whether under public or private ownership, and, while recognizing and taking much pains to discuss the variations which in his opinion may be permitted under the two forms of ownership, goes rather far in proposing that the treatment should be very much the same in either case.

Few of the earlier writers have gone so far as Dr. Raymond in advocating, or at least approving, assessments for benefits as a means of meeting part of the first cost of utilities. He recognizes that this is not economically practicable for some of the utilities and not legally practicable, as matters now stand, in others; but he does not stop there; he says what should be done with the cost that he feels should be met by benefit assessments when these cannot be or are not made.

A puzzling thing about the book is its failure to mention earlier ones in the same field, either in the text, in footnotes, or, what might at the least be expected for a variety of reasons, in a bibliography. There are ample references to court decisions, a few citations of utility commission rulings, mention of methods used or opinions advanced by two or three engineers, and a very limited number of references to standards established by utility associations. Under water supply, a subject of importance to many of the readers of this journal, not only does the author fail to mention the valuable studies made by committees and individual members of the American and New England Water Works Associations but in addition the book gives the impression that the author is quite unaware of these studies, including particularly a committee report on meter rates for water, subsequently expanded into a book, and widely recognized among the water-works fraternity.

The failings mentioned—if failings they be—are of minor importance. The book as a whole promises to be practically useful and unusually provocative of thought and discussion.

Readable Survey of Public Finance

PUBLIC FINANCE—By Harley Leist Lutz, Ph.D., Professor of Economics in Leland Stanford, Jr., University; Author of "The State Tax Commission"; Co-author of "An Introduction to Economics." New York and London: D. Appleton and Co. Cloth; 6 x 8 in.; pp. 681. $4.

The growing attention that is being given to public finance is attested by the recent publication of several books on the subject and by the comprehensive character of Professor Lutz's new book. After a brief Introduction the author takes up Public Expenditures, their classification, increase, economic effects and control, local and central. There follows naturally a section on Public Revenues, Except Taxation and a separate part on Taxation. The first of these sections deals with revenues from lands and forests, state and municipal industries, and administrative revenues. The section on Taxation reviews the theory of the subject, the distribution of the tax burden and attempts to escape it, the general property and other forms of taxation. The concluding sections take up Public Credit, in theory and practice, and Financial Administration and Legislation, with 40 pp. on The Budget.

The author attempts little in the way of new theory but summarizes and criticizes the principal theories previously advanced, expresses dissent or approval and in some cases offers theories of his own. He presents ample statistical data where needed, but some of these need correlation with changes in the purchasing power of the dollar.

John E. Sweet Biography and Memorial

JOHN EDSON SWEET: A Story of Achievement in Engineering and of Influence Upon Men—By Albert W. Smith, Dean Emeritus, Sibley College of Mechanical Engineering, Cornell University. New York: The American Society of Mechanical Engineers. Cloth; 6x9 in.; pp. 220; frontispiece and 14 illustrations. Cloth; $3.75; morocco, $7.50.

As leader in founding the American Society of Mechanical Engineers, third president of the society and one of its staunch supporters throughout his life, John Edson Sweet deserves first place in what we hope will prove to be a series of biographies published by the Society. Sweet was a self-educated engineer, an inventor, a teacher and a manufacturer. This volume tells of his birth in central New York in 1832, his early farm life there, his ten years as a carpenter and draftsman in America, his first travels in Europe and his work as a draftsman and promoter of one of his early inventions in England, his shop work in Syracuse and later employment there and elsewhere in bridge building under Howard Soule, his years at Cornell from 1873-79 in charge of the machine shop and professor of practical mechanics, and then of his long career as head of the Straight Line Engine Works at Syracuse and his later travels in Europe, Egypt and Palestine. Besides his straight-line engine, the principal work of Sweet as an inventor or developer was a measuring machine, a 16-in. lathe, a traversing machine and a gas compressor, the latter being one of many machines which he perfected or helped develop for the Solvay Process Co. A hotel at Selma, Ala., shows Sweet as an architect in the early 60's and presumably the effect of his early studies of Ruskin. Sweet was starting construction on this building when the war broke out. Thirty years later it was built after his original plans.

In addition to the many papers and discussions which Sweet contributed to the American Society of Mechanical Engineers, the pages of *The American Machinist* bear some 270 titles by him, and he contributed many letters on travel to the daily press in Syracuse during his trips abroad. Excerpts from these letters and from his occasional addresses are given in Dean Smith's biography and reveal much of the character of a man who made a great impress upon a wide circle. His effect upon his students at Cornell, in the 70's, including some of the most notable mechanical engineers of later years, was remarkable.

All these things are well told in this book, which is partly biography and partly a memorial volume, and does credit to all concerned in its preparation and publication, Dean Smith as author and compiler, the Committee of the American Society of Mechanical Engineers, and the society itself.

Water Supplies for Single Buildings

THE WATER SUPPLY OF BUILDINGS AND RURAL COMMUNITIES: For Engineers, Architects, Plumbers and Property Owners—By Walter S. L. Cleverdon, M. Am. Soc. C. E., Associate Professor of Sanitary Engineering, New York University; Formerly Assistant Engineer, Department of Water Supply, Gas and Electricity, and Board of Water Supply, New York City. New York: D. Van Nostrand Co. Cloth; 5 x 8 in.; pp. 186; 59 halftones, line cuts and plates; Appendix of 23 charts and tables. $2.50.

Although the title of this useful book includes the words "rural communities" the volume is addressed chiefly to the needs of single buildings, of large or fair size, supplied from a municipal water-works plant, although the buildings may have their source of supply. The short introductory chapter is on water and water flow under pressure, the effect of water on the metals used in water supply systems, pipe laying, fitting and plumbing. A lengthy chapter deals with pumps of various kinds, house services, meters, regulating valves, tanks and hot water supplies. There are then a half dozen pages on laying out and installing water supplies, as many pages designed for owners and superintendents of buildings, a dozen pages on maintenance, and finally a variety of "tabulated data." The treatment is clear, no mathematics beyond arithmetic is used and in general the book is well suited to the use of those responsible for the design, construction or maintenance of water supplies for buildings, under conditions demanding little concern as to either the development or maintenance of the source of supply.

World Power Conference

THE TRANSACTIONS OF THE FIRST WORLD POWER CONFERENCE, London, June 30 to July 12, 1924: Volumes I, II, III, IV. London: Percy Lund Humphries & Co., Ltd. Cloth; 7 x 10 in.; pages as follows: Vol. I 1506, Vol. II 1599, Vol. III 1502, Vol. IV 1816; many charts and tables, halftones, insert plates and maps—some in color; index in separate volume. Four Volumes, I to IV, £10; index £2; both in London.

It is impossible to give in any space permissible in the limits of a review an adequate appraisal of the value of each of the papers in this monumental collection. There are four 7x10-in. volumes, each with over 1,500 pages, totaling 6,423 pages of papers on the science of water-power production, distribution and utilization. Contributors came from all over the world. Every phase of the power problem is treated exhaustively. Never before has there been brought together so much detailed information on this subject of such growing importance. Indeed the vast accumulation of so much information may serve to defeat the very purpose of the volumes, because they are so large and imposing as to make casual or consecutive reading an impossibility. As a reference work, however, they should be indispensable.

All that can be done is to recite some of the subjects which are treated. Vol. I is devoted to the power resources of the world, availablle and utilized. Every country had its representative, and each representative recited in some detail, with appropriate statistical reference, the present and possible power developments of his home country. This we believe has never before been statistically recorded. Vol. II is devoted to water-power production, the preparation of fuels, and steam-power production. It is an engineering volume, with the papers devoted to engineering details. Vol. III covers internal combustion engines, gas and fuels, power from other sources, power transmission and distribution, standardization and research, and illumination. The titles are descriptions of the contents of the papers. Vol. IV is devoted to power in industry, and the methods used in electro-chemistry and electro-metallurgy, and for transport, as well as to economic aspects of power resources and to the more general subjects of education, health and publicity.

As *Engineering News-Record* stated editorially at the time of the conference a year ago, the volumes "constitute an admirable record of present-day practice in power development and transmission, and in addition put on record for the first time a fairly complete statement of the power resources of the globe, habited and uninhabited regions alike." Those who contributed to such a giant task, and especially those who carried through the conduct of the meetings and the collection of the papers in this mammoth form, are to be congratulated.

The How, Why and Whither of Our Suburbs

THE SUBURBAN TREND—By Harlan Paul Douglass, Author of "The Little Town." New York and London: The Century Co. Cloth; 5 x 8 in.; pp. 340; some maps and charts, bibliography. $2.

Never before has the American suburb been so thoroughly dissected as is here done by Mr. Douglass. The study is a fascinating one even though it is chiefly an assemblage of data with tentative and sometimes rather indefinite conclusions. Such, however, pioneer surveys must often be, unless there is constant resort to dogmatism, which Mr. Douglass avoids. At the close of the book the author is more constructive than before and makes it evident that the time has come to attempt control of those parts of the "suburban trend" that are undirected or selfishly misdirected, this control to take the form of town and regional planning.

The main topics of the book are types and varieties of suburbs; the cost of suburban living (which the author rightly says is so high as to force out many sons and daughters); suburban society, institutions, and social deficiencies; the rural side of the suburban trend; and—wherein come the ideas on planning—decentralization of cities and the "suburban evangel," heralding something akin to the garden city or village. Appendixes add to the statistical data previously given. A Bibliography concludes the volume, which throughout is interesting and stimulating.

The chief improvement or enlargement which we venture to suggest for a later edition is an exposition of the fact that a large part of the cost of suburban public improvements is due to the sprawlingness of the suburbs—not merely the small number of families per acre, which the author recognizes, but also the many vacant intervening lots and the straggling subdvisions with no houses between, entailing a high acreage cost of improvements per family. Much of this is due to one of the motives for suburban life—a desire for plenty of elbow room or breathing space—but this can be had without "sprawling all over creation." The garden city and the agricultural belt or, if preferred, agricultural gores or sections, centralize both building operations and open spaces and make for orderly economy. Planning of this sort the author seeks to encourage at the end of his valuable study but he does not fully show its economic importance.

Engineering Principles of Public Health

THE PRINCIPLES OF PUBLIC HEALTH ENGINEERING—By Earle B. Phelps, B.S., Professor of Sanitary Engineering, College of Physicians and Surgeons, Columbia University. Formerly Associate Professor of Chemical Biology, Massachusetts Institute of Technology. New York: The Macmillan Co. Cloth; 6 x 9 in.; pp. 265; 35 charts and drawings; index. $3.

There are many books on public health that take up its engineering phases and many on sanitary engineering that deal with public health but this is the first book on Public Health Engineering. It is condensed, the author says, from material for a course in Public Health Engineering first offered at the 1924 Columbia University Summer School. It is designed for two quite distinct classes of advanced students, one trained in medicine and the other in engineering, both with little or no public health background. Very properly, therefore, it deals with principles rather than with practice. It is notable for its scientific spirit and method throughout, for its grasp of essentials, and for its thorough accord with progressive ideas of what's what in that part of public health work with which it deals—all of which is to be expected from its widely experienced and well-known author.

The book deals with ventilation, water supply, sewage disposal, milk pasteurization, lighting, municipal refuse, mosquitoes and flies, the last three subjects coming in a chapter on Miscellaneous Environmental Control.

The space devoted to milk pasteurization is significant. It reflects not only the part that safer milk is playing and is yet to play in public health work but also the fact that to be efficient pasteurization must be under engineering control.

The section on lighting deserves special commendation—not merely because of the way the subject is treated but because it is given so much prominence. There is new hope for the future of public health work when a book on its underlying principles gives five times the space to lighting that it devotes to garbage and refuse collection and disposal.

Inasmuch as one of the commendable features of the book is its brevity we hesitate to suggest enlargement but there are a few untouched subjects that might be briefly mentioned in a later edition. Heating seems to deserve more than a passing reference under ventilation. Street cleaning, which is not mentioned, might well be given a few words. The control of offensive odors is now so much before state sanitary engineers and engineers in private practice that it might be given more specific consideration than it receives. The milk supply has other public health aspects than those associated with pasteurization. A few sentences on each of these subjects would take but little space—which if need be could be got by condensation in other sections of the book.

None of the omissions just mentioned, if omissions they be, seriously detract from Professor Phelps' book, which deserves and doubtless will find wide use in the schools and in both health board and engineering offices. It will be particularly valuable for engineers in general practice, who wish to broaden or bring to date their knowledge of the principles of public health engineering, as well as to those who have perhaps overspecialized in some and neglected others of the topics so admirably covered in this book.

PUBLICATIONS RECEIVED

JUST WHAT ORGANISMS cause taste, odor, turbidity or other troubles in water, the characteristics of the organisms and the troubles and the means of control widely used in the past decades are told in The Use of Copper Sulphates in Control of Microscopic Organisms, a 16-p. illustrated pamphlet written by Dr. Frank E. Hale, director of laboratories, Department of Water Supply, New York City (The Nichols Copper Co., 25 Broad St., New York City).

A VARIETY OF INFORMATION on the subjects indicated by its title is given in the 1925 *Journal* of the American Association for Promoting Hygiene and Public Baths (Arthur Morton Crane, manager, Roselle Park, N. J.).

STATISTICS FOR EIGHT YEARS are given in Wages and Hours of Labor in the Iron and Steel Industry: 1907 to 1924, just published as Bulletin 381, U. S. Bureau of Labor Statistics (20c. from Superintendent Public Documents, Washington, D. C.).

THE CONSERVATIVE BRITISH VIEW on some phases of plumbing is given in House Drainage with Special Reference to the Intercepting (Disconnecting) Trap, a paper

read last December by H. Alfred Roechling, a well-known engineer in England, and now published as a 52-p. pamphlet. With the paper is included the discussion which followed its reading. Some of the discussion, notably that by A. J. Martin, a past-president of the society named below, is flatfootedly against Mr. Roechling's contentions for the disconnecting trap, but the author of the paper also has as hearty support as he could wish. (The Institution of Sanitary Engineers, 120 Victoria St., Westminster, London, S. W. 1, England; 2 shillings in England.)

FEASIBILITY STUDIES of seven proposed irrigation projects in Washington, Oregon, Nevada, Utah and Wyoming, from engineering, agricultural and economic viewpoints, make up a 272-p. illustrated paper covered volume prepared under the direction of Dr. Elwood Mead, commissioner, Bureau of Reclamation (Washington, D. C.). The engineering reports take up the location, the irrigation plan and water supply and the costs of each project and the water reports go into many details, such as drainage, topography, climate, finances, schools, churches, banks, etc.

FOR A NICKEL one can get from the Superintendent of Documents, Washington, D. C., a short, interesting illustrated paper on Protection of Small Water Supplies Used by Railroads, written by O. E. Brownell, assistant engineer, Minnesota State Board of Health (Reprint 952, U. S. Public Health Reports, Sept. 5, 1924).

FULL DETAILS OF STUDIES OF EXCESSIVE TYPHOID FEVER last winter in New York, Chicago and other cities are given in the final report on the subject issued as Supplement 50 to the Public Health Reports. The title of the 102-p. pamphlet is A Typhoid Fever Epidemic Caused by Oyster-Borne Infection (1924-25). The authors are Surgeons L. L. Lumsden, H. E. Hasseltine and J. P. Leake, and Assistant Surgeon M. V. Veldee. The introduction gives credit for a part in the studies to Sanitary Engineer H. R. Crohurst, Assistant Sanitary Engineer E. C. Sullivan and Associate Sanitary Engineer Joel I. Connolly, Mr. Sullivan having "been in touch with the situation in New York City from the first recognition of the outbreak." The conclusions of the report are the same as those given in the preliminary report, printed in full in *Engineering News-Record*, Feb. 29, 1925, p. 324. (20c. from Superintendent of Documents, Washington, D. C.)

THE BONDED DEBT of some 200 large American cities, with distribution by main purposes, is summarized by C. E. Rightor in the June *National Municipal Review* (261 Broadway, New York City) and the summary has been reprinted in a thin pamphlet. This is Mr. Rightor's third annual collection and summary of these figures.

HOT WATER STORAGE TANKS is the subject of Simplified Practice Recommendation No. 25, a collaborative effort of the U. S. Department of Commerce and the U. S. Bureau of Standards (5c. from Superintendent of Documents, Washington, D. C.).

DRY ROT IN BUILDINGS and Stored Construction Materials and How to Combat It, by C. J. Humphrey and L. E. Miles, has been issued as Circular 78, Extension Service, Alabama Polytechnic Institute, Auburn, Ala.

A REVISED EDITION of its Heating and Ventilating Code of the State of Wisconsin has been issued by the Industrial Commission of Wisconsin (Madison, Wis.).

CONCRETE BUILDING UNITS are the subject of Simplified Practice Recommendation No. 32, of the United States Department of Commerce. The bulletin lists standard sizes, concrete building units, block, tile and brick which were agreed upon in a conference at which were representatives of concrete products associations, manufacturers of concrete products, the American Concrete Institute, and the Department of Commerce. The sizes are the same as those recommended by Committee P-1 of the American Concrete Institute and adopted by that institute at its last meeting.

THE PORTS of Seattle, Tacoma, Bellingham, Everett, and Grays Harbor, Wash., are described in Port Series No. 7, and the ports of Gulfport and Pascagoula, Miss., in Port Series No. 19, the tenth and eleventh volumes of a series of reports upon the ports of this country being prepared by the Board of Engineers for Rivers and Harbors, War Department, in co-operation with the Bureau of Research, United States Shipping Board. These volumes give full information in regard to port and harbor conditions, port customs and regulations, services and charges, fuel and supplies, railroad and steamship lines. The railroad rate situation as affecting competition between transcontinental railroads and intercoastal steamship lines is outlined in No. 7. (Superintendent of Documents, Government Printing Office, Washington, Port Series No. 7, $1.70. Port Series No. 19, $0.30.)

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

BACTERIOLOGY: A Text Book on Fundamentals—By Stanley Thomas, M.S., M.A., Associate Professor of Bacteriology, Lehigh University. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 201; line cuts and halftones. $2.50.

FESTIGKEIT DER SCHIFFE—Von Dr. Phil. W. Dahlmann, Dipl.-Ing. Dozent an der Technischen Staatslehranstalten und am Technischen Vorlesungswesen, Hamburg. Berlin: Julius Springer. Paper; 6x9 in.; pp. 196; 129 line cuts and 28 tables. Paper, 18 marks, cloth, 19.5 marks, gold, in Germany.

HYDRAULICS—By R. L. Daugherty, A.B., M.E., Professor of Mechanical Engineering, California Institute of Technology, formerly Professor of Hydraulic Engineering, Rensselaer Polytechnic Institute. Third Edition. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 335; 258 halftones and line cuts. $3.

The present edition has been entirely rewritten and considerably enlarged. Besides bringing the subject matter up to date, changes in arrangement and methods of presentation suggested by use have been made. A "new and better method of determining pipe friction" is given, "which is valid for any fluid under any condition." The first edition was reviewed in *Engineering News*, July 20, 1916, by R. E. Horton, and in *Engineering Record*, July 22, 1916, by A. G. Hillberg. The second edition was briefly noted in these columns for Nov. 13-20, 1919, p. 892.

PRACTICAL ROAD-BUILDING THROUGH CANADA: A Manual—By E. A. James, M. Engineering Inst. of Canada, M. Am. Soc. C.E., Chief Engineer, Toronto and York Roads Commission, Member of firm of James, Proctor & Redfern. Toronto, Ont.: The Author. Cloth; 6x9 in.; pp. 227; many halftones and line cuts. $2.50.

PRINCIPLES OF MACHINE DESIGN—By C. A. Norman, Professor of Machine Design in Ohio State University, M. Am. Soc. M.E., M. Soc. Automotive Engrs. (Engineering Science Series.) New York: The Macmillan Co. Cloth; 6x9 in.; pp. 710; 585 line cuts and halftones, 106 tables; index. $6.50.

THE REGULARIZATION OF EMPLOYMENT: A Study in the Prevention of Unemployment—By H. Feldman, Ph.D., Assistant Professor, Industrial Relations, Amos Tuck School of Administration and Finance, Dartmouth College. Published under the auspices of the American Management Association. New York and London: Harper & Brothers, Publishers. Cloth; 6x8 in.; pp. 437; index. $3.50.

STANDARD IRON-STEEL-METAL DIRECTORY, 1925: Manufacturers, Classified Lists, Purchasing Agents, Standard Specifications, Metal Brands, Buyers Guide. Fourth Edition. New York: Atlas Publishing Co., Inc. Cloth; 6x10 in.; pp. 1586; index. $10.

First, all steel mills, blast furnaces, iron, brass and aluminum foundries, and non-ferrous metal smelters are listed by states and cities, with capital, chief officers, etc., and materials produced as well as raw products consumed; then, some of the information is given in classified form under the various industries; finally, a statistical section gives generally accepted trade specifications for various materials.

TECHNISCHE WIRTSCHAFTSLEHRE: Leitfaden zur Einführung des Technikers in die Wirtschaftswissenschaften—Von Theodor Janssen, Professor, Königl. Regierungsbaumeister a. D. zu Berlin. Leipzig, Germany: Wilhelm Engelmann. Cloth; 8x11 in.; pp. 379; 3 abbildungen. Paper, 13 marks; cloth, 16 marks, gold, in Germany.

Treats of the economics of production and distribution, largely from the technical viewpoint, and in the thoroughgoing German way.

THEORIE UND KONSTANTENBESTIMMUNG DES HYDROMETRISCHEN FLÜGELS—Von Dr.-Ing. L. A. Ott. Berlin: Julius Springer. Paper; pp. 49; 25 abbildungen; 3 zahlentafeln. Paper, 4.5 marks, gold, in Germany.

DAS TORKRETVERFAHREN UND SEINE TECHNISCHEN PROBLEME—Von Dr.-Ing. Adalbert Szilard. Berlin: Julius Springer. Paper; 6x9 in.; pp. 65; 25 halftones and line cuts. Paper, 3 marks, gold, in Germany.

DIE VEREINFACHTE BERECHNUNG BIEGSAMER PLATTEN—Von Dr.-Ing. H. Marcus, Direktor der Huta Hoch- und Tiefbau-Akt.-Ges., Breslau. Berlin: Julius Springer. Paper; pp. 92; 33 abbildungen. Paper, 5.1 marks, gold, in Germany.

VERKEHR UND BETRIEB DER EISENBAHNEN—Von Otto Blum, Dr.-Ing. ord. Professor an der Techn. Hochschule zu Hannover, G. Jacobi, Dr.-Ing. Oberregierungsbaurat der Reichsbahndirektion Erfurt, und Kurt Risch, Dr.-Ing. ord. Professor an der Techn. Hochschule zu Hannover. [Handbibliothek für Bauingenieure (herausgegen von Robert Otzen); II. Teil, Eisenbahnwesen und Städtebau, 8 Band.] Boards; 7x10 in.; pp. 411; 86 line cuts and plates; Index. 21 marks, gold, in Germany.

WIND UND WÄRME BEI DER BERECHNUNG HOHER SCHORNSTEINE AUS EISENBETON—Von Dr.-Ing. Karl Döring, Ludwigshafen a. Rhr. Mit einem Geleitwort von Dipl.-Ing. Hermann Goebel, Oberingenieur der Badischen Anilin-u. Sodafabrik, Ludwigshafen a. Rh. Berlin: Julius Springer. Paper; 8x11 in.; pp. 61; 69 abbildungen und 3 tafeln. Paper, 4.5 marks, gold, in Germany.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Credit to A. A. E.

Sir—My attention has just been called to your editorial "Questionable Activity" in the July 2 issue of *Engineering News-Record* and while I am deeply appreciative of the high compliment paid me for merely doing a duty, I cannot refrain from calling your attention to an unintentional omission in your editorial. While it is true that the Western Society of Engineers has supported us, it was the American Association of Engineers, H. Almert, national president, and R. C. Kellogg, president of the Metropolitan chapter, who stood on the firing line from the very first and are still bearing the brunt of the battle. So it is to these gentlemen and their organization that Chicago is indebted and on behalf of Colonel A. A. Sprague, commissioner of public works, I take pleasure in acknowledging their able assistance.

WILLIAM ARTINGSTALL,
Consulting Engineer, Department of Public Works.

Chicago, Ill.,
July 9, 1925.

Accelerated Sand Tests With Alumina Cement

Sir—In connection with the article in *Engineering News-Record*, June 18, 1925, p. 1014, by S. B. Slack and J. E. Boyd on the use of high-early-strength cement for accelerated tests of sand, the work described hereinafter may be of interest.

During the second semester of 1924-25 two students (P. E. Geiselman and F. L. Fowler) at the University of Tennessee conducted experiments on three kinds of sand, using portland and alumina cements. Their experiments consisted in forming the standard test for sand, using the two kinds of cement. Their object was to discover whether alumina cement with a 24-hour test might not be substituted for portland cement with 7- and 28-day test.

Before making briquets the sand was subjected to the standard test for moisture and sieve analysis. The cement was tested for fineness, normal consistency, etc. The sand briquets were made according to the standard method recommended by American Society of Testing Materials. The three sands used were fine sand from Tennessee River, coarse sand from Tennessee River, and limestone screening. The fineness moduli of these three sands were as follows:

Tennessee River fine 2.01.
Tennessee River coarse 3.15.
Limestone screening 1.70.

The following table gives the average result of a large number of briquets:

TENSION

	Portland cement				Alumina cement	
	7-day		28-day		24-hour	
	Strength	Ratio	Strength	Ratio	Strength	Ratio
Ottawa	218	1.0	350	1.0	361	1.0
Tenn. River fine	160	0.73	224	.064	248	0.69
Tenn. River coarse	334	1.53	373	1.07	425	1.29
Limestone screening	245	1.12	321	0.92	407	1.13

COMPRESSION

	Portland cement				Alumina cement	
	7-day		28-day		24-hour	
	Strength	Ratio	Strength	Ratio	Strength	Ratio
Ottawa	1320	1.00	1960	1.00	3952	1.00
Tenn. River fine	1022	0.77	1330	0.68	2755	0.70
Tenn. River coarse	1574	1.19	1556*	0.79	4290	1.05
Limestone screening	1753	1.32	2800	1.42	2685	0.68

* Apparently poor specimens.

It will be noted from the tensile tests that the three sands tested are placed in the same order by the portland and alumina cement. It is doubtful whether either test gives a real index to value of the sand as a concreting material.

The compression test places the fine sand and the coarse sand in the same order, but the limestone screening "falls down" with the alumina cement. The study was not carried far enough to undertake an explanation of this difference. Previous experiments in the laboratory have shown that the limestone screening with portland cement has unusually high tensile and compressive strength.

N. W. DOUGHERTY,
Professor of Civil Engineering,
University of Tennessee.

Knoxville, Tenn.,
July 6, 1925.

Is This a Concrete Placing Record?

Sir—In March of this year on our Exchequer dam job near Merced, Calif., we poured 47,000 cu.yd. of concrete in 26 working days using two 2-yd. mixers and working two 8-hr. shifts. We excavated, washed and screened the sand and gravel for this output and shipped it 20 miles by rail.

We are wondering whether any one has beaten this for a month's output and thought perhaps you might think it would excite a little interest to publish this in the form of a challenge and invite replies.

BENT BROTHERS, INC.,
By Arthur S. Bent.

Los Angeles, Calif.
July 8, 1925.

Sanitary Protection of Water Supplies Taken from National Forest Areas

Sir—In the article on a "New Gravity Water Supply for Staunton, Va.," in your issue of May 14, 1925, p. 803, the following sentence occurs: "The drainage area of 25 sq.mi. is situated in the National Forest Reserve, and therefore free from pollution." In the West, at least, it does not follow that because a drainage area is in a National Forest Reserve the runoff is free from pollution; about the only restriction to visiting the National Forest Reserves here is that you put out your camp fire. Temporary camp sites are provided at frequent intervals, and numerous areas are set apart for summer cabins. A cabin site rents for $5 a year.

It seems strange for an engineer to say that a water supply is free from pollution because the drainage area is in the National Forest Reserve. There is certainly some other precaution.

J. B. MARCELLUS,
Professor of Civil Engineering,
University of Colorado.

Boulder, Colo.,
May 28, 1925.

[Besides submitting the foregoing letter from Professor Marcellus to Mr. Williamson, author of the article in question, we have obtained a statement from Richard Messer, chief engineer, Virginia State Board of Health, as to the Staunton supply and the protection afforded it by the State Board of Health, and also a statement from L. F. Knopp, assistant forester, U. S. Forest Service, as to (1) the general policy of the Forest Service (or Department of Agriculture) in protecting public water supplies taken from drainage areas in the National Forest Reserve and (2) the protection afforded to the Staunton supply, the case under consideration. Letters from Mr. Williamson, author of the article, from Mr. Messer and from Mr. Knopp follow.—EDITOR.]

Sir—The sentence in question is probably somewhat misleading, due to its brevity. The facts are that the keeper at the reservoir will also be a forest ranger. All camp sites in this area are located approximately six miles below the storage reservoir and, naturally, a very careful watch will be kept on the drainage area. The State Board of Health will also issue such regulations as it sees fit for the protection of the drainage area; moreover, the supply is fully protected with chlorine.

I can easily see how the sentence could be misinterpreted. However, the latter part "and therefore free from pollution" literally means that the city has ample opportunity to safeguard its supply by federal, state and municipal regulations.

LEE H. WILLIAMSON.

Charlottesville, Va.,
June 4, 1925.

Sir—The National Forest Reserve within which the drainage area is situated is somewhat different from those referred to by Professor Marcellus. This reserve will be maintained by the U. S. Government for the purpose of the control and growing of timber. There will be no habitations nor camp sites and the area will be patrolled by federal agents. So far as possible, hunters and fishermen will be

kept off the drainage area. Under such conditions the chances for pollution are remote.

Furthermore, the 150-m.g. impounding reservoir will safeguard the supply to a certain extent. It should also be mentioned that the system has been designed so that slow sand filters may be constructed in the future if necessary; also chlorination may be provided if the bacteria tests indicate that such treatment should be given.

RICHARD MESSER,
Chief Engineer, State Board of Health.

Richmond, Va.
June 6, 1925.

Sir—A great many cities and towns situated adjacent to the National Forests obtain their water supply from lands located within the boundaries of the forests. It has always been the policy and practice of the Forest Service in administering such lands to go as far as it can in co-operating with the municipalities in maintaining the purity of the water supply. In a number of cases the Forest Service has entered into co-operative agreements with municipalities, which contemplate a restricted use of the watersheds. The regulation approved by the Secretary of Agriculture on this subject is as follows:

"When necessary for the protection of water supplies of towns, cities, or irrigation districts, the Secretary of Agriculture will enter into formal agreements with the properly authorized officials of the town, city, or irrigation district, to restrict certain prescribed forms of use upon the National Forest lands from which the water supplies are derived. The forms of use to be restricted, the nature and extent of the restrictions, the special protective measures which may be necessary or desirable, the assistance to be given the Forest Service in the enforcement thereof by the town, city or district, and the payments, if any, which shall be made to compensate the United States resulting from the restrictions proposed, shall all be clearly and specifically defined in the agreement."

In cases where camp sites or summer homes are located on National Forest lands lying within such watersheds, special consideration is given to their effect on the water supply and conditions are inserted in the permit which reduce the possibility of pollution of the water to a minimum. These conditions usually receive the approval of the local health authorities.

If any use whatever is made of a watershed there is of course possibility of the water being contaminated. Sanitary engineers, as you doubtless know, are not in entire accord as to whether it is entirely safe to use water for domestic purposes unless it has been filtered or treated in some manner which will insure its purity. The municipalities which obtain their water supplies from the National Forests apparently are satisfied with the ordinary restrictions imposed by the Forest Service on the use of their watersheds since only a small proportion of them have shown any desire or inclination to enter into the special co-operative agreements under which more complete watershed protection may be secured.

It so happens that the city of Staunton, Va., to which Dr. Marcellus refers, has a co-operative watershed agreement with the Department of Agriculture. The details of this agreement are as follows:

"The city, subject to the laws of the State of Virginia, may use any and all of the waters on the lands in question, construct such diverting, storage, and other structures as may be necessary for the use of the water, install and maintain necessary pipe lines and tunnels. Uses of these lands other than the following will be permitted only with the approval of the Secretary: (1) Measures necessary for the protection and maintenance of the forest; (2) the establishment of a game refuge; (3) the construction of roads, trails, telephone lines, etc. All persons employed on or occupying any of said lands are required to comply with the regulations governing the forest, and such sanitary regulations as may be proposed by the city and approved by the secretary. The secretary agrees, so far as practicable, to extend and improve the forest growth upon said lands by seeding planting, good silviculture, etc. Camping or the construction or occupation of buildings not needed by the city or the Forest Service are prohibited.

"Until such time as the city may demonstrate that such grazing is inimical to the use of the area as a source of municipal water supply, not to exceed 320 head of cattle under existing permits may continue to be grazed within the area. No new permits can be issued.

"The general expense of fire protection is borne by the federal government. If considered necessary by the Forest Service, the city provides a patrol of the area for fire protection and the enforcement of sanitary measures. The city is given authority to construct, if it so desires, and to maintain at its own expense, a wire fence around said lands. The city agrees not to cut or remove timber except with the permission of the Forest Supervisor. The Forest Service agrees to allow the removal, by sale or otherwise, of only such timber as in the judgment of the supervisor may be removed without injury to the water supply. If the city objects to such sale or concurs in the withdrawal of such timber from sale, it agrees to pay annually an interest charge of 3 per cent on the value of the forest products, the sale of which is prevented. The city pays an annual fee of $1,000, but the amount of fees collected for grazing privileges is credited in part payment of this rental. There is a provision for readjustments of the rental rate at the expiration of 35 years. The privilege granted to the city is not transferable. It is further understood and agreed that the agreement cannot be construed to grant to the city of Staunton the right to take water from North River as against any riparian owner other than the United States of America."

L. F. KNOPP,
Assistant Forester.

Washington, D. C.
June 9, 1925.

Rapid Track Laying Devices

Sir—I have read with interest the article on the construction of the Florida Western & Northern R.R. in *Engineering News-Record*, June 4, 1925, p. 927.

Reading this article brought to my mind a small track-laying machine, which I made and used, a description of which may interest some one who has a comparatively small mileage to lay.

The rails were loaded near the center line of two flat cars on cross skids about 8 in. thick. Very substantially built flanged cast-steel rollers were mounted in a frame on each side of the cars. The top of the flanges of the rollers was slightly below the top of the cross skids on which the rails were placed. The rails were slid onto the rollers and advanced over the end of the car. Two cars of rails and four of ties made up a train. Mounted over the rail cars was a gravity tie conveyor, the front end just clearing the load of rails; the rear end was elevated enough so that ties would run forward by gravity on level track. The tie conveyor extended some distance in front of the front rail car. The second rail car was the same as the first, except the tie conveyor was higher so as to deliver onto the conveyor of first car.

Tie cars were all flats. The first tie car had a permanent platform high enough for the men carrying ties to place them on the conveyor. Behind this platform the ties were racked down as this car was unloaded so as to form a walkway.

There were aprons between cars. Men carried the ties forward to the conveyor which was kept full. A man with a boat hook controlled the flow of ties to the tie gang on the ground.

Another interesting and time saving device which I have never seen used on a track-laying outfit was installed on this work.

As the rails were laid on the ties and the bars or joint plates were placed, instead of waiting for the men to run up two wrench-tight track bolts we had many large heavy C clamps made which fitted under the rail and clamped the two bars securely. A hand wheel operated the screw of the clamps to get speed and a wrench was used at the last to get the bars up snug. These clamps could be made tight in from 10 to 15 seconds.

The rails were spiked, joints, quarters and centers, and the train advanced. As soon as the train passed a joint the bolts were inserted, tightened and the clamps sent ahead for use again. One clamp was mostly sufficient for one joint, although two were used sometimes. Time is money—this was a time saver.

Two trains were used, one on the work laying steel and one loaded with rails, ties, spikes and bolts.

SAMUEL P. BAIRD,
Engineer and Contractor.

Columbus, Ohio,
June 22, 1925.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Eleven Men Indicted for Criminal Negligence

Architect, Contractors and Inspectors Charged With Blame for Fatal Boston Collapse

Indictments were returned on July 11 and 13 against eleven Boston men, charging them with criminal negligence and responsibility for the accident at the old Beach St. building in Boston which housed the Pickwick Club, where 44 were killed on the early morning of July 4 by the collapse of the entire structure. Among the indicted are G. C. Funk, architect; Hyman Bloomberg, lessee of the building; J. L. Pultz, of the Pultz Construction Co., J. M. Tobin, his superintendent, and L. J. Perkins, foreman, engaged in building a garage on the adjoining lot; Nathan Fritz, contractor for the repair of the Pickwick Club building after its damage by fire; E. W. Roemer, superintendent of construction in the city building department; and J. J. Hendricks, city building inspector.

Investigations of the collapse of the building have been made for the district attorney by a commission of engineers, but no facts have been made public to indicate that the cause of the disaster has been determined. Conditions as known at present are as follows: The building was a five-story brick structure 45 ft. wide by 65 ft. long, with floors carried on 3x12-in. wooden joists spaced about 15 in. on centers, built into the wall at each end the thickness of one brick, and supported in the center by a row of columns and girders. The joists were connected to the walls by occasional iron anchors. The rear wall faced on an alley 4 ft. wide, separating it from another building. On the easterly side a smaller building formerly adjoined, but this had been removed in April to make way for a much larger structure, a garage, for which excavation was in progress. The wall of the Pickwick Club building facing on this excavation was 20 in. thick for its full height. It was recently underpinned by seven concrete piers 2 ft. thick by 4 ft. long on top, belled out at the bottom so that their bases were substantially in contact. The wall was not shored up at the time of the accident. Excavation for the garage had proceeded to about the level of the bottom of the wall, or somewhat below.

All of the seven underpinning piers of the wall now are tipped outwardly, and one of them is lying on its side in the excavation. The rear foundation wall, just inside the line of the east wall, shows a large crack, wider at the top than at the bottom.

Ground level in the cellar of the Pickwick Club building was about 14 ft. above the bottom of the adjoining excavation. For about 6 ft. down the soil is sandy, while below this level blue clay is found.

Engineering Fifty Years Ago

From *Engineering News*, July, 1875

Notes on Building Material

HYDRAULIC mortar was first made in London, in 1796, from the septaria in the isle of Thanet. Roman cement contains from 30 to 40 per cent of clay, and hardens in a quarter of an hour. When clayey limestones are calcined, the theory is that the silicate which is formed when mixed with water, takes up water of crystallization like plaster of Paris, and becomes as hard as rock.

An instance is on record of 1 000 bricks being well and permanently laid in a hour by a single workman. This was done for a wager nearly fifty years ago in the front of the old City of London Tavern, now the site of the Wesleyan Centenary Hall.

Oak timber in the pier at Calais have endured without decay for more than seventy years.

Report Made on Wynooche Water Power Development

In a report upon the Wynooche power development proposed by the City of Aberdeen, Wash., Carl F. Uhden, former chief engineer on construction of the Skagit River hydroelectric power plant, states that 15,000 hp. can be developed at a cost of $2,639,000 and that the gross revenue from the initial installations would, at the prevailing rate for power in a number of Pacific Coast cities, be more than double the revenue necessary to take care of the annual charges. As a result of his report, the City of Aberdeen will submit a $2,639,000 bond issue to the voters this summer.

Highway Terms to Be Standardized

Standardization of a large number of technical terms referring to highways in the English, Spanish and Portuguese languages is to be one of the results of the Pan-American Congress of Highways at Buenos Aires in October, according to the Pan-American Confederation for Highway Education. At the present time, many words connote different things in the different countries and frequently in various parts of the same country. It is proposed, therefore, to compile a glossary of all terms which may be useful to highway engineers in which each word will be precisely defined and its exact equivalent in Spanish, English and Portuguese given. The North American delegation will present to the Congress a tentative glossary, which will be discussed and amplified at that time.

News Brevities

Pier Construction on the Bellaire-Benwood Bridge across the Ohio River began on July 7. The Vang Construction Co. is contractor.

A Transporter Bridge of suspension type is being built across the Gironde River at Bordeaux, France. It will serve roadway traffic at a point where better highway communication is badly needed.

A Break in the Outfall Sewer of New Rochelle, N. Y., near the Hudson Amusement Park, led Dr. Edward Codding, city health commissioner, to order all the bathers out of the water on Sunday afternoon, July 12.

A Bridge Building Program for Multnomah County, Oregon, for the next ten years will be established soon by Gustav Lindenthal, consulting engineer on Portland bridges. Mr. Lindenthal has just completed an inspection of three sites for proposed bridges across the Willamette River, north of the Portland Broadway bridge.

Rimrock Dam of the Yakima Project of the Federal Reclamation Service was dedicated on July 2, in the presence of the Secretary of the Interior, Senator W. L. Jones of Washington, and other federal and state officials. Senator Jones gave the structure the name Tieton Dam. After the manner of shipbuilding customs, a bottle of Yakima apple cider was "broken on the crest of the dam."

Whether Carbon Monoxide Exists in the atmosphere of New York City in such quantities as to be injurious to health is to be the subject of an investigation made at the testing laboratories of the Health Department under the general direction of Dr. Frank J. Monaghan, Commissioner of Health. Air samples will be collected at points of heaviest automobile traffic. The testing device used is said to be a combination of one employed by the Bureau of Mines and one used by the Fixed Nitrogen Research Laboratory to measure carbon monoxide.

The Public Service Commission of Pennsylvania at a hearing in Philadelphia on June 26 stated that it would not rule upon the application of the Philadelphia Electric Co. for authority to construct its proposed plant at Conowingo, Md., until it had further information concerning the financing and feasibility of the project and until the inter-corporate agreement between the Philadelphia Electric Co. and its subsidiary company which is to construct the hydro-electric plant makes better provision for the protection of the Pennsylvania commission's right to regulate future rates.

Bodies of Paul Norcross and E. H. Bowser Found

The body of Paul H. Norcross, consulting engineer of Atlanta, Ga., who was among those lost at the time of the sinking of the Norman at Cow Island Bend in the Mississippi River on May 8, was found in the river by fishermen at a point opposite Peter's Landing, Ark., on July 8. The body was taken to Atlanta for burial. Rev. Virgil C. Norcross, father of Paul Norcross, died at Atlanta the day following the finding of his son's body, without his having learned of its recovery.

The body of E. H. Bowser, another victim of the Norman accident, was found in the river at Commerce Landing about 38 miles below the point where the Norman sank. Seven bodies are still missing.

The board of inquiry investigating the cause of the accident resumed its sittings on July 13.

Railroad to be Bought to Aid Warrior Barge Line

Plans are about to be perfected for the purchase of the Ensley Southern R.R. by the municipality of Birmingsport, General T. Q. Ashburn, executive officer of the government Inland Waterways Corporation, reports. This 26 miles of railroad must be operated in close co-operation with the Warrior River barges to insure their success and to give Birmingham the full benefit of water transportation, General Ashburn thinks. The railroad now is in the hands of a receiver.

The Warrior River operations of the government's experiment in water transportation never have been profitable but by securing reasonable divisions with the road connecting the head of navigation with Birmingham and with the improvement of port facilities at Mobile, now going forward, General Ashburn believes these recurring deficits and drains on the profits earned on the Mississippi, can be wiped out. General W. L. Sibert, who has been engaged by Mobile in connection with its port development plans, has recommended facilities that will permit of direct loading of coal and iron ore at the docks.

Contract for $459,000 Incinerator at Buffalo Signed

Failure of Mayor Schwab, of Buffalo, to get an injunction against the purchase of land for an incinerator site and against executing a contract for the construction of an incinerator, as noted in our issue of July 9, p. 76, was followed by the signing of the contract by William F. Schwartz, one of Mayor Schwab's fellow commissioners under the commission-plan charter. This, however, was just before the New York State home rule constitutional amendment was declared invalid (see our issue of July 9, p. 77). Permission to appeal from the last-named decision has been given and it is expected that Mayor Schwab will also appeal from the decision rendered against him, but neither appeal will come to a hearing before next autumn.

Proposed Legislation Affecting Interstate Motor Traffic

An agreement on principles of legislation for the regulation of motor vehicle common carriers engaged in interstate operation was reached at the national conference of independent bus and truck operators of the country held in Washington D. C., recently. Every section of the country was represented and it was the unanimous belief that the question of regulation is an inevitable development. A resolution was adopted without a dissenting vote endorsing the following principles as the basis on which the independent operators represented in the conference desire regulation to be developed.

First, that the Interstate Commerce Commission be authorized by Act of Congress to pass on the question of certificates of public convenience and necessity in interstate motor vehicle commerce.

Second, that the I.C.C. should grant such a certificate as a matter of course if the request for it is accompanied by a certificate from the State Public Utilities Commission.

Third, that the I.C.C. should act as board of arbitration in case the State Utilities Commission refuse a certificate.

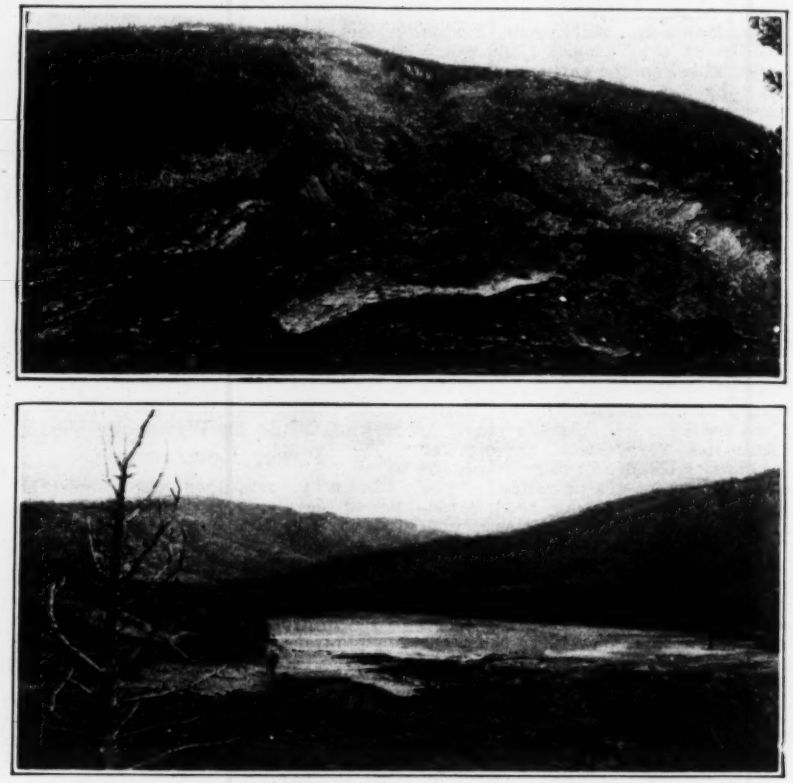
Fourth, that in the matter of detailed regulation such as taxation, equipment, safety and schedules the state body should control.

Fifth, that in the granting of certificates the I.C.C. shall take into consideration existing motor transportation facilities.

Sixth, that operators engaged in business on March 3, 1925 be regarded as entitled to a certificate, on the basis that they have afforded *prima facie* evidence that they are engaged in business because of "public convenience and necessity."

Landslide Dams the Gros Ventre River in Wide Canyon

A landslide from the side of Sheep Mountain which occurred on June 23 partly filled the Gros Ventre Canyon near Kelly, Wyoming, and completely dammed up the Gros Ventre River. The slide started high up on the mountainside and extended over an area approximately 3,000 ft. long. When it reached the valley it spread out to a width of nearly a mile and formed a dam across the valley estimated to be 225 ft. high at its highest point. The river is completely shut off and is now filling the reservoir formed above the dam. Farms lying in the valley above the dam are being inundated and those below are deprived of water for irrigation purposes. The slide is supposed to have been caused by earthquake tremors which were quite general throughout the region.



ABOVE, LANDSLIDE ON SHEEP MOUNTAIN; BELOW, DEBRIS FROM LANDSLIDE FORMING DAM ACROSS GROS VENTRE CANYON

No details as to the character of the material making up the dam or as to its exact dimensions are available at the present time but it is expected that more complete reports will be made at a later date.

Zoning Law of Washington, D. C., Upheld by District Court

That part of the zoning law of the District of Columbia enacted by the Congress of the United States was upheld in a decision of the District Supreme Court on July 6. The decision was in a mandamus suit brought to compel the district authorities to issue a permit to make alterations so that property on Columbia Road could be used for business purposes. Incidentally, the court held that the failure of the applicant to state just what business purposes the property was to be used for when altered might have been considered sufficient to bar the application for a mandamus, although the denial was on broader grounds. This view of the case was based on the fact that the court considered that it might take into account reasonableness in some cases. Aside from the point just made, the opinion of the court was as follows:

"In my opinion, the zoning law is within the constitutional power of Congress, being included in the police power as defined by the Supreme Court in C., B. & Q. Railway Co. vs. Drainage Commissioners, 200 U. S., 561, where the court said:

" 'We hold that the police power of a State embraces regulations designed to promote the public convenience or the general prosperity, as well as regulations designed to promote the public health, the public morals or the public safety.'

"The particular provisions of the zoning regulations attacked in this case, those prohibiting business houses in residential sections, are in my opinion designed to promote the public convenience as well as the public health and safety, and this I find to be the case, both as a matter of common knowledge and from the testimony introduced by the defendant. There seems to be nothing arbitrary or unreasonable in this limitation on the use of property in resident sections or in the particular section in which relator's property lies.

"I think, too, that the effect of the decision in Hadarcheck vs. Sebastian, 239 U. S., 394, is to sustain the power of the Legislature to prohibit the conduct of any business in a residential neighborhood as being in the nature of a nuisance in such a location.

Southern Pacific Building Port Terminal near Houston

The Southern Pacific Company is building the first unit of a modern ship and rail terminal on its water-front properties along the Houston ship channel in Texas. It is to be of the slip and pier type, consisting of a slip 225 ft. wide and a ship frontage of 1,000 ft. The wharf and bulkhead will be of reinforced concrete. The transit shed and warehouses will contain 150,000 ft. of floor space and will be built of structural steel with asbestos protected metal siding. The estimated cost is $1,000,000. The dredging and grading work is practically completed and it is anticipated that the entire first unit will be completed before the end of the year.

Study of Earth Road Development

Prof. S. F. Steinberg of the University of Maryland has been designated acting secretary of the new investigation begun by the Highway Research Board of the National Research Council on the development of earth roads. The object of this investigation, which will be national in scope, is to co-ordinate the efforts and data already available on the improvement of earth roads and to stimulate further research in order to find an inexpensive surface that will carry intermediate traffic at a low cost of both construction and maintenance.

Calumet Harbor Ordinance Passed

A contract ordinance between the city of Chicago and the New York, Chicago & St. Louis R.R., which has been passed and signed by the mayor, provides for the preliminary work of developing a harbor in Lake Calumet, a 2,300-acre shallow body of water accessible from Lake Michigan by the Calumet River with a six-mile channel 200 ft. wide and 21 ft. deep. The railroad is to dredge a channel of similar dimensions through the lake, with two branches to future slips, the dredged material being utilized, for filling low land. In return, the company is granted filled land on which to establish freight yards and shops, and is given the right-of-way for a belt line around the lake, to be known as the Calumet Harbor R. R.

Ontario Hydro Gets Authority to Develop Power on Ottawa River

The provincial government of Ontario has authorized the Ontario Hydro-Electric Power Commission to proceed with the development of power at five sites on the Ottawa River in the neighborhood of the city of Ottawa. The sites to be developed are Rocher Fendus Rapids at the south side of Calumet Island, Chenaux Rapids, 52 miles west of Ottawa, Chat Falls, 32 miles west of Ottawa, Deschene Rapids at Ottawa embracing the head from the existing development at Chaudiere Falls to the foot of Chat Falls, and Carillon Rapids, including the fall at Point Fortune and at Hawkesbury. Estimates of the power available at these sites vary from 250,000 to 400,000 horsepower. The estimated cost of development is placed at $25,000,000.

The portion of the Ottawa River where these sites are located lies on the inter-provincial boundary and consequently the development of power can only be undertaken by agreement between the provinces of Ontario and Quebec. The chairman of the Ontario Hydro Commission, in commenting upon the proposed work, is reported to have said that the Commission has been authorized to undertake this work in order that it should be in a position to negotiate with the province of Quebec and with private interests holding rights to some of the power sites with a view to proceeding with the development as soon as possible.

Engineering Employment Prospects Are Bright

A survey of national conditions affecting engineering employment by the employment department of the American Association of Engineers is optimistic. June activities have been good with future prospects even better.

Oil refineries have shown improvement, particularly in the Southwest. Chemical engineering has not been doing much outside of the junior vacancies for men with limited experience. The most favorable point in the industrial situation is the fact that considerable additions, betterments, and repairs are getting under way from the standpoint of construction.

Municipal and sanitary fields have been exceptionally active throughout the month for both field and office engineers.

Indications point to a heavy demand for designers in this field particularly qualified men on sewers and sewage disposal plants.

Construction has been along residential work principally. Industrial activities have not been as heavy as expected, but indications are that this work will be carried through the present year.

Florida has shown a heavy amount of public improvement, and also a heavy demand for civil engineers on municipal, highway work and sub-divisions, surveys and general development. All indications point to continued activity along this line for years to come.

The railroads are building necessary projects, yet retrenchment has also been indicated by some of the roads, particularly affecting certain territories and certain classes of men in the engineering corps; and in some instances affecting men of long maintenance experience.

The call for engineers during the month has emphasized particularly the demand for experience. The 1925 group of graduate engineers in general have been offered a good opportunity for acquiring experience.

Twenty-Seven New Buildings for Duke University

Twenty-seven new buildings are to be built at Duke University, Durham, North Carolina, as part of the improvement program made possible by the gifts of James B. Duke. The building program will be carried out in two separate units, the first calling for the erection of eleven new buildings on the present campus costing approximately $3,600,000, and when these buildings are completed the second unit consisting of sixteen new buildings to be erected on the south side of the railroad on property recently purchased by the University will be commenced. The remodeling of the present buildings will be undertaken upon the completion of the first unit. The first unit, together with the present buildings, will be used by the University until the second unit is completed, at which time the men's college will move to the second unit and the present campus will be occupied by the college for women.

WASHINGTON NOTES

Applications for licenses covering two sites on the Tennessee River below Muscle Shoals have been filed with the Federal Power Commission. The Mississippi Power Co. proposes to build a dam 55 ft. high and approximately one mile long in the Tennessee River at Parkers Landing, near Iuka, Miss. The Muscle Shoals Hydro Electridg Co. proposes to construct a 50-ft. dam across the Tennessee at Riverton, Ala. This dam would be just below the mouth of the government canal at Colbert Shoals. Both companies are associated with the Alabama Power Co.

The two sites are ten miles apart. The Iuka dam would create 66,000 hp. of primary power. An initial installation of 100,000 hp. is proposed. At Colbert Shoals the primary power is estimated at 60,000 hp., while 90,000 hp. would be installed at that point.

It is stated that the applicants are prepared to begin construction work immediately as they already have acquired the necessary riparian rights and have made the preliminary engineering studies. The two projects call for the ultimate expenditure of $22,000,000.

A report favoring the issuance of a preliminary permit to the Hiwassee River Power Company has resulted from the field investigations of the Federal Power Commission. The project is an important one on the Hiwassee River on the border between North Carolina and Georgia. The construction of three dams is proposed. One, to go in near the town of Murphy, is to be 40 feet high. Another, at Island Ford, 140 feet high and a third, near the mouth of Tusquitee Creek, 125 feet high. There will be a power house at each dam. The initial installation will be 28,000 hp.

The Interstate Commerce Commission recently handed down an opinion favoring more liberal treatment for the barge line in the matter of divisions of revenue earned jointly with the railroads. To this Commissioner McChord dissented in what is regarded as a significant statement. Among other things he said:

"I dissent from the finding of the majority with respect to the divisions accorded the barge line. These divisions should be larger. It is shown that, under economical operation, with the divisions proposed by the barge line the latter will be able to operate and pay expenses. Any divisions lower than these will in all probability make it extremely difficult for the barge line to operate without loss. It is not shown that the divisions accorded the rail lines will be inadequate.

"The declared policy of Congress is 'to promote, encourage, and develop water transportation, service, and facilities in connection with the commerce of the United States, and to foster and preserve in full vigor both rail and water transportation.' To accomplish this purpose water lines must be accorded divisions of joint rates with rail lines that will be at least adequate to pay their operating expenses, unless it clearly appears that the resultant divisions to the rail lines are so low as seriously to impair their operations. No such showing with respect to the rail lines is made in this case.

"It is settled that we may, in the public interest, take into consideration the financial needs of a weaker carrier and that such a carrier 'may be given a division larger than justice merely as between the parties would suggest' in order to maintain it in effective operation as part of an adequate transportation system,' provided the share left to its connections is 'adequate to avoid a confiscatory result.'

"There is much said in the majority report to the effect that, on the one hand, everything that can be done ought to be done to give this experiment in water line operation a fair opportunity to demonstrate its worth but that, on the other hand, the experiment will not be fairly conducted if the barge line is permitted to tap the resources of the rail lines by depriving them in any way of just compensation for the services they perform in connection with its operation.

"Clearly, that which ought to be done is to give the barge line adequate divisions. This can be done. It is not shown that the large resources and earnings of the Louisville and Nashville will be unjustly affected thereby, or that the compensation allowed it will be unfair."

"The Supreme Court, apparently, is ready to go farther than the majority of the Commission, for that Court says in the passages hereinbefore quoted that 'the weak were to be helped by preventing needed revenue from passing to prosperous connections' and a weaker carrier 'may be given a division larger than justice merely as between the parties would suggest.'"

Rapid progress is being made with the boring and shaft sinking being done in connection with the investigation of foundation conditions at various points along the St. Lawrence River, members of the Joint Engineering Board report after a tour of inspection. Col. William Kelly and Lieut. Col. George B. Pillsbury, in company with two of the Canadian members of the board, looked over the work between Ogdensburg and Cornwall. General Edgar Jadwin, the assistant Chief of Engineers, was not able to make the trip at that time, but a few days later traversed the same area with Colonel Pillsbury.

In addition to the investigations of foundation conditions two surveying parties under the direction of Captain Joseph H. Stephenson are at work. All field operations are under the direction of C. W. Sturtevant.

In connection with the appeal of the Civil Service Commission for land appraisers to assist in valuing the real estate of the railroads it is stated that the work of valuation to date has cost the government $25,000,000 and has caused the carriers to spend $80,000,000.

The entire work is referred to as the greatest appraisal ever undertaken. The valuation involves 413,000 miles of track and property known to be worth approximately $20,000,000,000.

Buildings for Sesqui-Centennial Under Construction

New plans have been developed and preparations are now being pushed ahead rapidly for the sesqui-centennial celebration of American independence, to be held in Philadelphia in 1926. Col. David C. Collier, of San Diego, Calif., is director-general of the exposition. Colonel Collier was director-general of the Panama-Pacific Exposition in San Francisco in 1915 and commissioner-general for the United States at the Brazilian Centennial Exposition in Rio de Janeiro in 1922. The plans now being developed mark the reopening of the exposition plans that have been dormant for over a year.

The site chosen for the exposition is in the southern part of Philadelphia on a large tract of city-owned land now used for park purposes, and adjoining the Philadelphia Navy Yard. The erection of the exposition buildings is under way, the first to be begun being a $2,000,000 municipal stadium. This stadium will be a feature in the exposition plan, which will include structures for state, national, and international participation.

Building construction for the exposition has been placed under the direction of George H. Biles, director of the Philadelphia Department of Public Works. Detail plans for the buildings and other engineering features are now being developed. Some of the buildings will be of permanent character, but in general the construction will be of a type to assure completion by June 14, 1926, the date on which the exposition is scheduled to open.

Lehigh University Combines Business with Engineering

At the opening of the academic year in September, 1925, Lehigh University will inaugurate a new curriculum, leading to the degree of Bachelor of Science in Industrial Engineering. This action is in response to a growing demand for men trained in the elements of finance and management as well as in the fundamentals of mechanics and materials. The course is designed to meet the needs of those students who intend to enter industries essentially technical in character but who do not intend to go into the mechanical or technical departments.

The university believes that an equal division of the curriculum between so-called business courses and the engineering sciences will develop neither a man of adequate engineering ability nor a man equipped with the training of the school of business administration. The curriculum should be primarily an engineering curriculum. In planning the course the faculty provided that the work in the first two collegiate years shall be practically identical with that of the present mechanical and electrical engineering courses. During the third and fourth years work is about evenly divided between engineering courses and courses in the fundamentals of business —finance, accounting, statistics, and management. Work in an industrial plant during the summer vacation may be applied toward a degree.

Canadian National Railway to Build to Rouyn Gold Fields

The Premier of the Province of Quebec has announced that he has received definite assurance from the president of the Canadian National Railway that the construction of the projected extension of the C.N.R. from a point on the National Transcontinental near O'Brien to the Rouyn gold fields will be proceeded with immediately. This line is longer and more difficult to build than the projected line of the Ontario government railway, the T. & N. O. and is estimated to require 18 months to build.

Civil Service Examinations

UNITED STATES

For the following civil service examinations apply to the U. S. Civil Service Commission, Washington, D. C., or to any local office of the commission.

Assistant Scientific Aid and Junior Scientific Aid—Vacancies in U. S. Bureau of Standards, Washington, D. C., and in Departmental Service, at entrance salaries of $1,500 for assistant scientific aid and $1,320 for junior scientific aid.

Receipt of applications for these positions will close July 25, 1925.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER-WORKS ASSOCIATION, Boston, Mass.; Annual Convention in connection with trip on St. Lawrence River, Sept. 8-12, 1925.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Fall Meeting, Montreal, Que., Canada, Oct. 14-16, 1925.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City; Annual Convention, St. Louis, Mo., Oct. 19-22, 1925.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Lakeland, Fla.; Annual Meeting, Des Moines, Iowa, Oct. 26-30, 1925.

The Mississippi River Flood Control Association at its annual meeting at Memphis, elected the following officers for the ensuing year: W. H. Dick, Memphis, president; H. D. Tomlinson, Butler, Ark., vice-president, and Fred D. Beneke, Memphis, secretary. This is the fourth time that Mr. Dick has been elected president of the association.

The Colorado Section, American Society of Civil Engineers, has elected the following officers for the ensuing year: Lyman E. Bishop of Denver, president; F. R. Dungan of the University of Colorado, Boulder, Colo., vice-president; and C. A. Betts of the Moffat Tunnel Commission, secretary.

The California Section, American Water Works Association, will hold its sixth annual meeting at Santa Cruz, October 15-17, 1925. S. B. Morris, 25 East Union St., Pasadena, Calif., is secretary of the Section.

The XIV International Geological Congress will be held in Madrid, Spain, in May and June of 1926. Among the questions which will be discussed during the congress, the following are indicated up to now: the world's resources of phosphates and pyrites, geology of the Mediterranean-Cambrian and Silurian fauna, geology of Africa and its relation to that of Europe, and geophysical studies.

Those who wish to take part in this congress or to receive particulars about it, are requested to write to the Secretary of the organizing committee, instituto Geológico, Plaza de los Mostenses, Madrid, Spain.

Personal Notes

S. M. FELTON, president, Chicago Great Western Ry., and DANIEL WILLARD, president of the Baltimore & Ohio R.R., were among the 14 civilians who received certificates appointing them honorary advisers to the Army Industrial College on June 30. The certificates were awarded in recognition of "valuable contributions to the national security through industrial preparedness."

H. C. BOYDEN, of Chicago, national lecturer for the Portland Cement Association since 1919, has been appointed dean of the engineering department of Ohio Northern University, Ada, Ohio. The appointment is effective Sept. 1. Col. Boyden is a native of Massachusetts and a graduate of the civil engineering department of Worcester Polytechnic Institute, class of 1894. Before the war his engineering work included about twenty years of railway and highway construction experience with several eastern railroads, with the Santa Fé, and with the California State Highway Commission. He spent some time also in the U. S. Reclamation Service, and on public utilities valuation, the latter in California. During the War he was employed in organizing forces for the collection of military information in the United States.

Col. Boyden's appointment is coincident with a program of expansion in the engineering department of Ohio Northern University. Particular attention will be given to instruction in reinforced concrete design and construction and in the practical application of laboratory principles to field control of the quality of concrete.

STEPHEN GARDNER has been appointed Chicago representative for the engineering firm of McClellan and Junkersfeld, Inc. Mr. Gardner will continue as president of the Industrial Engineering and Sales Service, Inc., of Chicago.

BEN S. MORROW, principal assistant engineer, Water Bureau, Portland, Ore., has been appointed chief engineer, vice FRED M. RANDLETT, whose resignation was noted in this column last week.

Lieut. Col. J. H. PARKS, formerly connected with the construction department of the Backus-Brooks Co. of Kenora, Ontario, has been appointed a division engineer of the Board of Railway Commissioners of Canada. Col. Parks has had wide experience in railway construction work, including twelve years with South African Rys.

C. P. COLLINS, formerly manager of the Clarksburg Engineering Co., has purchased the interests of the Clarksburg Engineering Co. and will continue to practice civil engineering under his own name in Clarksburg, W. Va.

W. C. RUEGNITZ has been elected president of the Loyal Legion of Lumbermen. Mr. Ruegnitz is a civil engineering graduate from Armour Institute of Technology, Chicago, who began work as a day laborer with the Bates & Rogers Construction Co. of Chicago and worked himself up through the positions of foreman and superintendent to become manager for the company. In 1915 he became purchasing agent and employment manager for the Bridal Veil & Wind River Lumber Co. of Portland, Ore., and in 1921 was elected secretary of the Loyal Legion.

W. FREDERICK WELSCH has been promoted to the position of division engineer of the Bronx Parkway Commission and is in charge of engineering and construction work on the Bronx River Parkway Reservation, with headquarters in Bronxville, N. Y.

MARTIN BERNHARDT, New York City, has been appointed engineer in charge of the development of the Fox Meadows Estates, at Hartsdale, N. Y.; the work will consist of subdividing 400 acres and laying out and constructing a street and sewerage system.

Obituary

FRANK LAWRENCE SHELDON, one of the associates of F. B. Sheldon & Son, Providence, R. I., died in that city on June 22. Mr. Sheldon was born in Providence in 1883, and received his engineering training at Rensselaer Polytechnic Institute. After graduation, he entered his father's office, F. B. Sheldon & Son, in 1907 and remained with the firm, specializing in the design and equipment of manufacturing and industrial plants, until the time of his death.

HORACE D. GOULD, Davenport, Iowa, for the last 39 years engineer for the Davenport Water Co., died July 6 after a lingering illness. Mr. Gould was born in Rhode Island in 1858, and went to Davenport when a child.

WILLIAM C. DEAN, assistant engineer of maintenance, Philadelphia Bureau of Highways, died in that city June 29 following an operation for appendicitis. Mr. Dean went to the Philadelphia Bureau in 1913 as an inspector, which position he held until he was promoted to be assistant engineer three years ago. Previous to his work with the city he was with the Maryland State Highway Commission.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Construction Equipment—Past and Present

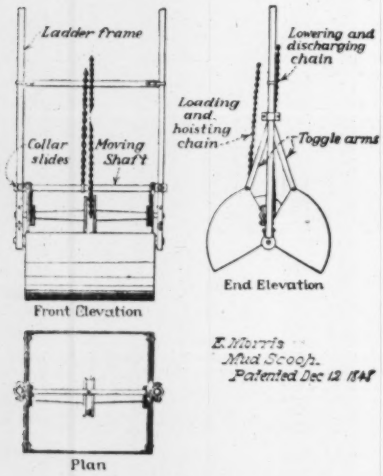
A Series of Historical Sketches of the Origin and Development of Machines for Contractors and Engineers

VII—Automatic Buckets

THE history of automatic closing buckets is a story of developments and changes in design along three distinct lines: first, developments and improvements in the closing mechanisms; second, changes in the shape of the buckets; and, finally, the incorporation of more durable materials in all styles of buckets.

There are meager accounts of tests and experiments having been made on closing buckets in Europe more than 200 years ago. These buckets first appeared in France where their invention is credited to M. Gouffe about 1703. His idea, however, must have lain dormant during the next three or four generations for nothing more is heard of it.

The Morris "Mud Scoop"—The granting of a patent to Ephraim Morris, of New York City, on Dec. 12, 1848, really marks the beginning of the history of the present type of automatic closing buckets. The patent was granted for a "mud scoop" that was made "to load and close itself and open to discharge the load by ropes or chains and pulleys that govern toggle-joint arms jointed to the upper parts of the scoop, the whole being attached to a movable boom derrick or shears that sustain the machine



Mud Scoop Patented by Ephraim Morris in 1848

by the same ropes or chains that control the movement of the working parts." The scoop was closed by drawing upon one chain; then it was raised, and opened for the discharge of its load by drawing upon a second chain. Such is a brief description of the construction and operation of the first two-line clamshell bucket, generically known as the grab bucket, now so widely used for excavating, dredging and rehandling material of all kinds. The Morris family evidently made considerable use of the invention for Augustus T. Morris took out a patent for improvement in 1856, and continued to take out further patents until 1874, applying the clamshell bucket to the end of a boom for dredging and dock construction. Charles Morris, later associated with the Hayward Co., also took out a number of patents for improvements on automatic buckets.

Early European Experiments—A revival of M. Gouffe's idea for an automatic bucket is recorded in Europe about 1882. At that time George Hone and Priestman Bros. were doing pioneer work in England, and tests were being made in Germany by Mohr, Federhoff, Jaeger and Solomon. Solomon arrived at several conclusions that proved useful in later design. Among these were the facts that the greatest resistance to penetration was met near the end of the closing motion, and that the shape of the shell had considerable effect upon the digging performance, curved shells providing the minimum resistance. In his first experiments he placed the axis of rotation on the center of the main hinge shaft, coincident with the radius of the shell, but later found that raising the axis of rotation above the radius of the shell increased the leverage and did not cause any increased resistance to penetration.

In the United States, during and following the Civil War, clamshell buckets similar in design to the Morris "mud scoop" were used along the Atlantic coast to dredge channels, keep ferry slips clean and dig shallow irrigation ditches. Judson Hayward, son of John H. Hayward, one of the pioneers in the automatic bucket field, relates in this connection: "Not yet forgotten in the minds of many of us is the sight of the old-type clamshell dredge with two long poles attached to the top of the bucket and running through rings at the boom end, swinging backward and forward as the boom swung over

First Power Wheel Bucket of Geo. Haiss Mfg. Co. Patented 1893

the scow or bank and deposited its load. This was as much of a landmark in New York harbor as the spire of Trinity Church or the gilded top of the World Building in the early days."

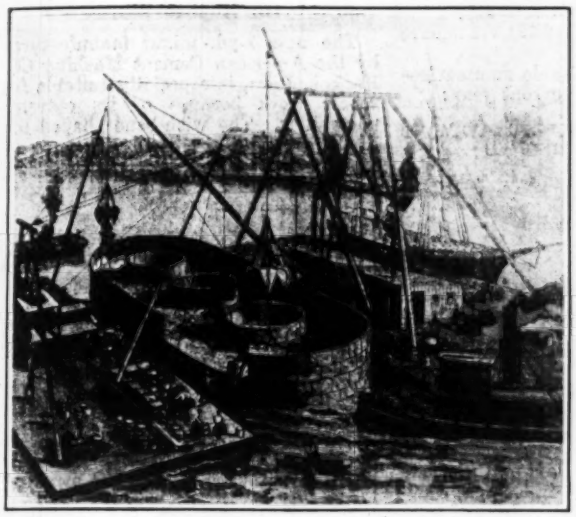
Labor Antagonistic—The necessity for improved methods of handling coal at the wharves along the Atlantic seaboard accentuated the development of the clamshell bucket on a commercial scale. Two of the firms prominent in this development, the Hayward Co. and Mead-Morrison Mfg. Co., are still making buckets of the same fundamental design as used on their earlier types. One of the difficulties experienced by the early manufacturers and contractors arose from the attitude of labor toward the automatic bucket. Stories are told of the wrecking of

In the Fiftieth Anniversary Issue of "Engineering News-Record," April 17, 1924, *p.* 667, *there appeared a summary of the development of construction machinery and an interpretation of its influence during the last half century. That review constituted an introduction to a series of special articles dealing with the origin and improvement of the more important types of contractors' equipment. These articles appeared in the following issues:*

I. The Rock Drill, April 24, 1924, *p.* 745.
II. The Power Shovel, May 1, 1924, *p.* 785.
III. The Concrete Mixer, May 8, 1924, *p.* 829.
IV. The Hoisting Engine, May 22, 1924, *p.* 917.
V. Surveying Instruments, June 5, 1924, *p.* 995.
VI. The Road Grader, Part I, July 10, 1924, *p.* 80; *Part II, July* 17, 1924, *p.* 120.

The article appearing herewith represents the seventh of this series of historical sketches.

buckets by mobs and of similar circumstances that made it difficult to keep a bucket in operation for any length of time. These conditions soon passed, however, as they have in the case of other labor-saving machinery where time has proved that there is plenty of room for both hand labor and the new mechanical devices.



Sinking Caissons on Hawkesbury Bridge, South Australia (1886); one of the earliest uses for orange peel buckets

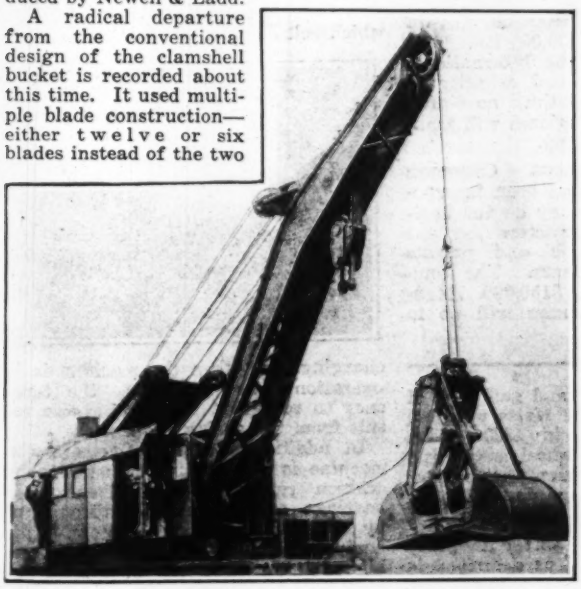
For handling coal one of the first clamshell buckets was being used in Boston in 1880, and was manufactured by the firm of Newell & Ladd, the predecessors of the present Mead-Morrison Mfg. Co. The men responsible for its invention and development were Ladd, Rawson, Newell, Morrison, Brown and Norris. The clamshell bucket, however, did not become generally recognized until about 1887, when several new models were introduced by Newell & Ladd.

A radical departure from the conventional design of the clamshell bucket is recorded about this time. It used multiple blade construction—either twelve or six blades instead of the two that characterized the clamshell bucket. This bucket was invented by a Dr. Johnson and developed by him and John H. Hayward, the founder of the Hayward Co. who died June 14, 1925. Mr. Hayward, after experimenting with this multi-blade bucket for some time reduced the number of blades first to four and later to three in order to effect a simple and more rugged construction.

Origin of Term Orange Peel — It was at this time that the multi-blade bucket became known as the "orange peel." Mr. Hayward was at a banquet one evening and upon cutting an orange into quarters noticed its resemblance to his four-bladed bucket. He immediately mentioned this resemblance to some of the other members of the party. The term proved to be such an accurate description that it has become the accepted name for the multi-blade bucket.

The orange peel bucket exerts a powerful digging force and is of heavier construction than the clamshell. The closing motion is the same as that used on many of the clamshell buckets.

Single Line Buckets—By far, the greater number of automatic buckets in use, then as now, operated by two lines, one called the closing line and the other called the hold line. Two hoisting drums are, therefore, necessary on all two-line buckets. During recent years, however, the single-line bucket has been so perfected as to be able to perform many kinds of service as satisfactorily as a two-line bucket.



Blaw-Knox Single Line Bucket

In single-line buckets there is always some kind of mechanism for opening the bucket while it is suspended on the closing line. Various kinds of mechanism for accomplishing this result have been patented, the earliest one in 1857, but only recently have the buckets come into general use. The earlier designs gave trouble in two respects: first, the opening of the bucket was attended by so much jar as to cause inconvenience and danger in operation, and second, various kinds of latches and locking devices were employed which were not safe, and caused the bucket to open prematurely.

Latest Type Power Wheel Bucket Made by Industrial Works

J. H. Hayward designed a single-line bucket that was used about 1888 for unloading coal on the East River at New York City. The first buckets built by the Brown Hoisting Machinery Co., in 1893, were of the single-rope type. Blaw-Knox developed a new single-line bucket in 1917 that contains no hooks or latches in the operating mechanism, and thus eliminates the more important wearing parts; instead of the hooks and latches, folding arms secure the lower block of these buckets. These arms must be thrown back by the operator before the bucket will open, or else the hoist line must be slackened causing the arm to fall back automatically when the line is again tightened. The single-line bucket may be applied to cranes, derricks, and hoists that have a single drum available for bucket duty. This feature is of special advantage to the contractor of the present who must make quick and economical changes from one type of work to another.

New Sheave Type Clamshell Made by Brown Hoisting Machinery Co.

Although there have been changes in the shape of buckets, and in the ma-

terials used, by far the greater amount of attention has been devoted to closing mechanisms. More than 350 patents for inventions or improvements on closing methods were taken out in the United States before the end of 1900, and by the present time this number has probably exceeded 800

Power Wheel Closing Mechanism—What is known varyingly as the power wheel, center wheel and bull wheel type

Modern Orange-Peel Bucket Built by Hayward Company

of closing mechanism is the same as that utilized by Morris on his "mud scoop." It is still one of the most common types, the majority of the present companies utilizing it on one or another of their models. All automatic buckets consist essentially of two scoops hinged together, and auxiliary members called corner bars or connecting rods which are hinged together, and hinged to the bowl, so that the structure as a whole is a four-hinged mechanism. The operation of closing the bucket is accomplished by the power wheel closing mechanism which winds the closing line around a large diameter pulley wheel mounted on an axle that forms part of the hinge of the scoop. Attached to this axle on each side of the wheel is one end of a chain or cable, the other ends being fastened to the top of the bucket near the hinge where the corner bars come together. These short power closing chains or cables wind on the axle of the power wheel as the closing line pulls the hinges together.

The power wheel bucket is used for excavating and rehandling, and has a large pick-up capacity in loose, soft materials. Other advantages of this type of closing mechanism lie in the fact that it operates very fast and requires little head-room.

The power wheel was the type of closing mechanism that was used on the Newell & Ladd "center wheel" bucket brought out in 1887 for coal handling with a mast and gaff type of unloading rig. George Haiss patented his clamshell bucket in 1893. This bucket used a power wheel mechanism and outside of refinements, there has been no radical change in design in the last 25 years.

(Later developments in the design of automatic buckets will be described in Part II of this article to appear in an early issue.)

Concrete Road Yardage

For June the square yardage included in concrete pavement contract awards, according to reports to the Portland Cement Association, were: 5,980,857 for roads; 3,904,733 for streets; and 335,981 for alleys; or a total for the month of 10,221,571 square yards.

The accompanying table summarizes the statistics for the current year:

SQUARE YARDS OF CONCRETE PAVEMENT AWARDED DURING 1925

Month	Roads	Streets	Alleys	Total All Classes
Jan....	3,474,421	963,256	75,236	4,512,913
Feb....	3,787,192	1,201,224	58,723	5,047,139
Mar....	5,728,862	2,483,662	190,553	8,403,077
Apr....	12,462,646	4,431,220	469,117	17,362,983
May....	7,724,075	4,169,707	392,656	12,286,438
June....	5,980,857	3,904,733	335,981	10,221,571
Total..	39,158,053	17,153,802	1,522,266	57,834,121

Business Notes

DURIRON CO., INC., Dayton, Ohio, has established a new office in Tampa, Florida, as an aid to M. W. Jay, district representative in New Orleans, in covering his territory which includes the state of Florida and the southern portions of Louisiana, Mississippi, and Alabama.

MARION STEAM SHOVEL CO., Marion, Ohio, announces the establishment of direct factory branch warehouses in San Francisco and Los Angeles. A complete line of replacement parts will be carried by R. P. Ryan and Bert Engstrom at San Francisco and by John Harvey at Los Angeles.

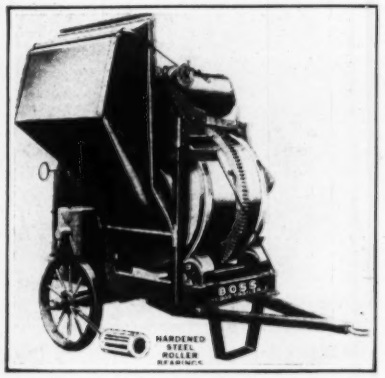
INTERNATIONAL CEMENT CORP., New York City, has recently acquired the properties of the Indiana Portland Cement Co., as a part of its expansion program. The Indiana Portland Cement Co. operates a plant between Terre Haute and Indianapolis with an annual capacity of 1,500,000 bbl. This acquisition will give the International Cement Corp. an annual capacity of 10,000,000 bbl. Executives now affiliated with the International will manage the Indiana company.

UNIVERSAL INTERLOCK CONCRETE CRIBBING CO., LTD., has been incorporated in Canada to carry on the business of general contractors for the construction of public and private works, and of engineers. The company is capitalized for $150,000. Headquarters of the company will be in Toronto.

Equipment and Materials

Portable Concrete Mixer for Repair Work

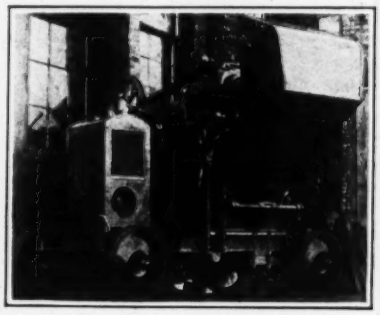
The new 1-yd. mixer manufactured by the American Cement Machine Co., Keokuk, Iowa, is especially suitable for repair work because of its extreme portability. The wish-bone shaped lift hitch, giving 10-in. road clearance, is easily attached to a truck; in addition,



this type of coupling is claimed to eliminate any whipping action. The wheels are equipped with solid rubber tires and are mounted on roller bearings. All steel construction is claimed to have reduced the weight over 1,000 lb. while maintaining ample capacity and durability. The machine is equipped with either power loader or low charger.

Spring Suspension for Mixer

The Knickerbocker Co., Jackson, Mich., provides as special equipment on its line of mixers, a truck mounting using quarter-elliptic springs on the rear axle and semi-elliptic springs on the front axle. Blocks are supplied which bolt down upon each axle on the



charging side when the machine is in operation thus eliminating the tendency to rock that would otherwise result from the spring suspension.

In addition to this refinement the machine is equipped with disk wheels, cushion rubber tires, Timken roller bearings, and is lubricated throughout by the Alemite pressure system. This equipment is especially adapted to highway work and can be trailed behind a car or truck at a speed of 25 to 30 miles per hour.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

June Public Bond Sales Lowest in Three Years

The June record of public bond sales shows fewer municipalities making offerings and in the number of separate issues according to *The Commercial and Financial Chronicle*. The awards totaled $138,096,285 compared with $242,451,538 for June a year ago. The issues for May aggregated $189,140,697. The number of separate awards for the past month was 610 made by 459 places while in June, 1924, there were 673 separate issues from 499 municipalities.

The more important issues placed during June, 1925, follows: $10,000,000 4½s road and highway bonds of the State of New Jersey; $10,000,000 4s 20-50 year bonds of Philadelphia, Pa.; $9,000,000 4½s by the State of North Carolina; $7,500,000 4½s road bonds of the State of Missouri; $6,000,000 4-4½s road bonds for West Virginia.

The total of state and municipal bonds awarded during the first six months of the present year stands now at $741,692,310, compared with $788,744,973 for the same period in 1924.

The rates in the following table range from 4 to 5 per cent. One award was made at par while all the others commanded a premium.

Business Briefs

Call money quoted at 4@5 per cent, July 13; year ago, 2 per cent.

Time loans: short terms, 3⅜@4 per cent; longer periods, 4@4½ per cent.

Commercial paper: best names, 4 per cent; other names, 4½ per cent.

FOREIGN EXCHANGE (DEMAND)

	Par	This Week	Last Week	Year Ago
Sterling	$4.86⅔	$4.85⅞	$4.85⅞	$4.38½
France	.193	.047	.0471¾	.0522
Lira	.193	.0369½	.0372½	.0433⅓
Mark	.238	.238	.238	
Florin	.402	.4004	.4007½	.3778
Peseta	.193	.145	.1454½	.1335
Krona	.268	.2684	.268	.266

This Week's Contracts—Week Ago—Same Week Last Year

The money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks.

Minimum costs observed are: $15,000 for water works and excavations, $25,000 for other public works, $40,000 for industrial and $150,000 for commercial buildings.

MONEY VALUE OF CONTRACTS LET—ENTIRE U. S.

Week Ending	Public Work	Private Work	Total Contracts
July 16, 1925	$32,291,000	$31,332,000	$63,623,000
July 9, 1925	12,346,000	7,817,000	20,163,000
July 17, 1924	15,869,000	28,753,000	44,622,000
Heaviest Week			
1924, May 8	26,370,000	38,829,000	65,199,000
1925, Apr. 2	43,603,000	27,633,000	71,236,000
Jan. 1 to Date			
1925	566,218,000	707,845,000	1,274,063,000
1924	568,150,000	604,174,000	1,172,324,000

REPRESENTATIVE PUBLIC BOND SALES, JUNE, 1925

State	Purpose	Amount	Rate per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Maryland	Bridge and grade loan	$300,000	4½	104.8741	3.88	June 15	Yearly	Estabrook & Co. and others
	Road loan	1,500,000						
Michigan	Highway Impvt.	1,419,000	4½	100.21	3.99		1940	A. M. Lamport & Co. of N. Y.
Missouri	Roads	7,500,000	4½	102.21	4.52	July 10	1933–39	Geo. H. Burr & Co. and others
North Carolina		9,000,000	4½		3.75–4.10	July 1	1926–35	The First National Bank and others
New Jersey	Highway	5,000,000	4½	103.173		July 1	1940	Local banks of New Jersey
	Road	3,000,000	4½	103.044				
	Bridge	2,000,000	4½	103.046				
Tennessee	Memorial	300,000	4½	102.03	3.96	July 1	1926–59	I. B. Tigrett & Co. of Jackson
	University debt	350,000						
West Virginia	Roads	6,000,000	4–4½	100.09	4.18	Jan. 1	1939–50	W. A. Harriman & Co. and others
County								
Allen, O.	Roads	91,000	5	102.84	4.36	June 1	1925–34	Braun, Bosworth & Co. of Toledo
Bertie, N. C	Road	150,000	4½	100.04	4.49	June 1	1930–59	C. W. McNear & Co. of Chicago
Beaver, Pa.	Road	500,000	4½	102.456	4.035	Aug. 1	1928–52	The Mellon Nat. Bank of Pittsburgh
Choctaw, Miss	Road	365,000	5½	100.34		April 1		Central State Nat. Bank of Memphis
Cecil, Md.	Lateral road	26,000	4½	102.6511	4.24	May 1	1930–43	Weilepp-Bruton & Co. of Baltimore
Crawford, Pa.	Highway	400,000	4	100.25	3.98	July 1	Yearly	Oil City Trust Co.
Clackamas, Ore.	Road	335,000	5	107.25	4.36	May 1	1936–45	A. D. Wakeman & Co. of Portland
Camden, N. J.	Road and bridge	158,000	4½	100.39	4.20	June 15	1927–31	Harris, Forbes & Co. of N. Y.
Chatham, N. C.	Road and bridge	71,000	5½	100.59	5.47		1956–60	Bray Bros. of Greensboro
Elkhart, Ind.	Road	81,000	4½	103.04	4.045	June 15	1926–45	Fletcher-American Co. of Indianapolis
Edgecombe, N. C.	Bridge	60,000	4½	100.62	4.46	July 1	1927–56	W. K. Terry & Co. of Toledo
Franklin, O.	Road work	125,000	4½	101.71	4.22	May 15	Every six months.	Hayden, Miller & Co. of Cleveland
Fayette, Tenn.	Court House	100,000	5	105.70	....	June 1	Serially in 30 years.	J. H. Hillsman & Co., Inc., of Atlanta
Franklin, O.	Impvts.	253,000	4½	101.80	4.35	.....	1926–33	Hayden, Miller & Co. of Cleveland
Fort Bend, Tex.	Road	675,000	5½	101.77		.....		Caldwell & Co. of Nashville
Gloucester, N. J.	Road	385,000	4½	100.32	4.20	June 20	1926–45	M. M. Freeman & Co. of Philadelphia
	Public Building	300,000	4½	100.74	4.17			
Genessee, Mich.	Roads	150,000	4½	100.27	4.19	June 15	1928–31	Continental & Commercial Trust & Savings Bank of Chicago
Hamilton, O.	Sewer	754,233	4½	102.95	4.13	June 1	1926–45	Estabrook & Co. and others
Herkimer, N. Y.	Highway	50,000	4½	104.76	4.05	July 1	1927–51	Sherwood & Merrifield, Inc., of N. Y.
Jefferson, Pa.	Road	200,000	4	100.56	4.07	June 1	1935–55	M. M. Freeman & Co. of Philadelphia
Shelby, Tenn.	School	375,000	4½	105.27	4.32	May 1	1935–54	Harris Trust & Savings Bank of Chicago
	Jail	100,000						
	Auditorium	75,000						
Township								
Brothers Valley, Pa.	Road	20,000	5	100.696	4.51	July 1	1926–45	A. B. Leach & Co., Inc., of Philadelphia
Franklin, Pa.	Roads	44,000	4½	102.12	4.11	July 1	1927–35	E. H. Rollins & Sons of Philadelphia
Hayesville, N. C.	Roads	25,000	5½	101	....	June 1	Serially in 30 years.	Ryan, Sutherland & Co. of Toledo
Municipal								
Albany, N. Y.	Public Impvt.	778,000	4	100.639	3.88	May 1	1926–65	The Guaranty Co. and Equitable Trust Co. of N. Y.
	Water Supply	280,000						
	Street Impvt.	653,000						
Akron, O.	Waterworks	350,000	4½	103.14	4.21	June 1	1926–50	Otis & Co. of Cleveland
	Sewers	76,800						
Atlanta, Ga.	Street Impvt.	58,000	4½	102.07	....	June 1	1 to 9 yrs.	Westcott, Kearr & Parrott of N. Y.
Beatrice, Neb.	Paving	26,465	4½	100	4½	April 1	1935	State of Nebraska
Bellaire, O.	Street Impvt.	38,975	5½	103.404	4.79	May 15	1926–35	Weal, Roth & Irving Co. of Cincinnati
Bridgeport, Conn.	Paving	500,000	4½	100.75	4.10	June 15	1926–35	H. L. Allen & Co. and others
	Construction	129,000						
La Crosse, Wis.	Street Impvt.	50,000	4½	101.10	4.12	July 1	1926–45	Second Ward Securities Co. of Milwaukee
	Water Main Ext.	45,000						

Weekly Construction Market

CONSTRUCTION as measured by money value of contracts awarded is at least 12 per cent ahead of a year ago to date.

Freight loadings for the first twenty-six weeks of this year are 24,297,628 compared with 23,185,152 for 1924.

Steel production for the first six months of this year is fully 13 per cent ahead of the same period of last year.

Bank debits or check payments continue to gain in volume and are at present heavier than for the corresponding period in 1923 or 1924.

Market for structural material is without any special feature. Price changes during the past week have been few. Linseed oil market shows no definite trend; declines at one point are counterbalanced by advances elsewhere. The new flax crop is just coming to market.

Stock conditions in the various cities reporting regularly to *Engineering News-Record* are good. Supply of all materials continues easy.

St. Louis in her building boom program is facing a shortage of building mechanics, especially bricklayers, plasterers and plumbers.

Crop conditions in the Northwest and Middle West are favorable and a prosperous condition prevails in the agricultural regions. The lower yields are being offset by better prices.

Lumber mills in the Western section report that new business for the past week was 37 per cent above production. Shipments were 3 per cent below new business. Cities in various sections of the country report building programs that exceed other records.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.90	$4.00	$3.10	$3.35	$3.07½	$3.30	$3.35	$4.25
Structural rivets, 100 lb.	4.50	4.45	—4.75	3.50	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.40	+3.38	3.00	3.25	3.62½	3.35	3.25	2.30
Steel pipe, black, 3½ to 6 in. lap, discount	48%	53.2%	45%	+59¼%	54.25%	36%	39.2@51%	50%	59.49
Cast-iron pipe, 6 in. and over, ton	50.60@51.60	54.00	54.00	48.20@50.20	53.00	62.00	52.00	53.00	55.00
Concreting Material									
Cement without bags, bbl.	2.50@2.60	2.40	2.05	1.95@2.20	2.42	2.84	2.52	2.65	1.80
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	—1.90@2.25	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd.	1.00	1.40	2.00	—1.90@2.25	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	—1.90@2.25	1.75	2.50	2.15	3.00	1.90
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	59.00	34.00	—56.00	45.00@55.00	38.75	36.25	27.00	23.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	+20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl.	2.50@2.75	1.45	1.85	1.35	1.35	2.70	1.60	2.80	9.50
Common brick, delivered, 1,000	19@20	10.50	+12.10	12.00	13.50	12.00	15.00	15.00	17.50
Hollow building tile, 4x12x12, per block	Not used	.0888	.10	.0888	.....	.085	.....	.10	.12
Hollow partition tile 4x12x12, per block	.1162	.0888	.10	.0888	.07	.085	.108	.10	.10
Linseed oil, raw, 5 bbl. lots, gal.	+1.04	—1.10	1.30	.99@1.02	1.06	—1.19	1.14	1.12	1.25
Common Labor									
Common labor, union, hour	.75	.30	...	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.75	.50@.55	.35@.50	.50	.50	.25@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 55c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of June 4, the next on July 2.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at par). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

LUMBER—Twenty-seven Weeks

	Production	Shipments	Orders
1925	6,527,450,171	6,456,375,255	6,283,546,035
1924	6,357,699,787	6,288,119,274	5,913,553,893
1925 Inc.	169,750,384	168,255,981	369,992,142

CEMENT—Six Months:	Production	Shipments
1925	44,697,000	48,630,000
1924	39,041,000	42,358,000

STEEL—Six Months, 1925—22,406,150 tons; 1924—19,737,034 tons.

On July 1, 1925

E. N.-R. Construction Cost Index Number 204.60

E. N.-R. Construction Volume Index Number 214

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month